

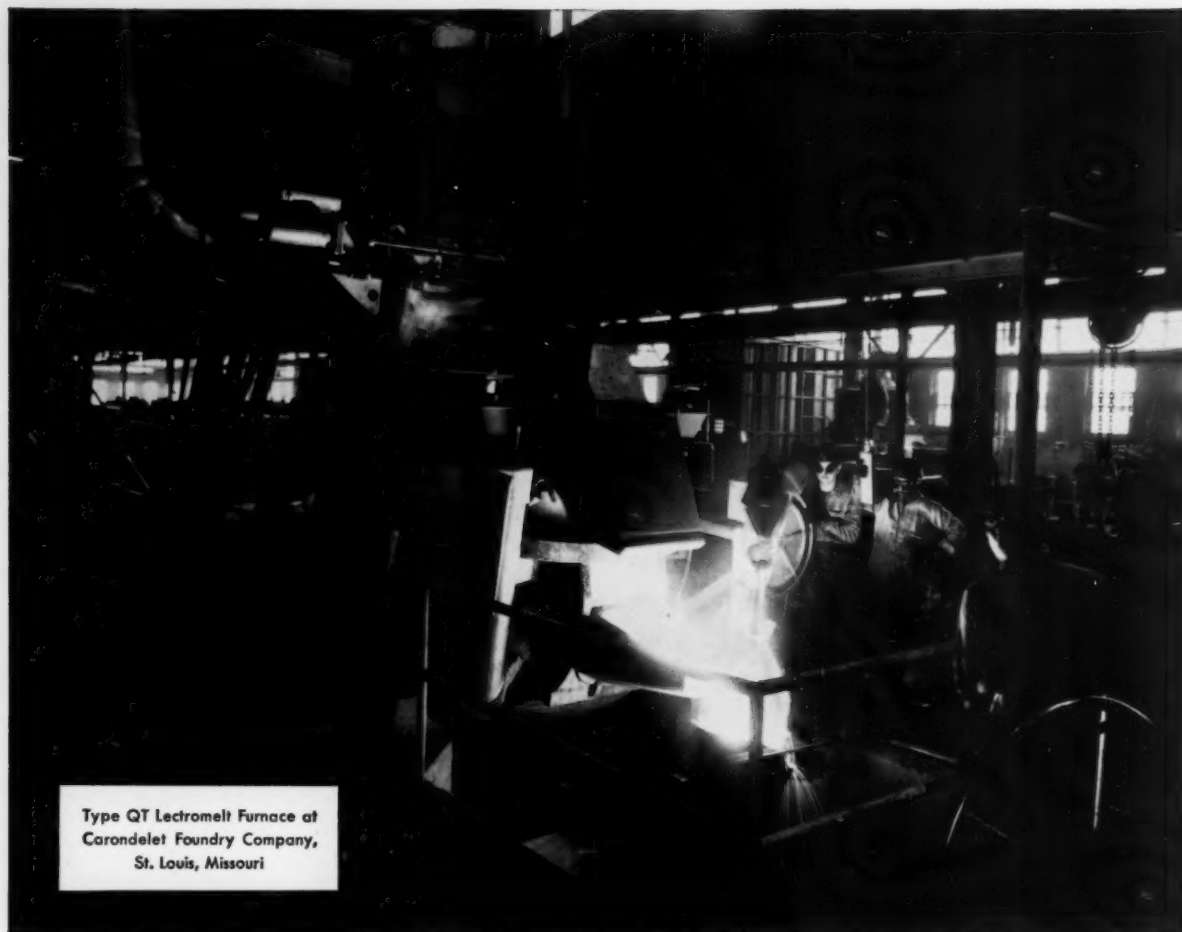
The Foundrymen's *Own* Magazine

American Foundryman

MARCH
1954

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- 49 Shell Molds for Titanium
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Type QT Lectromelt Furnace at
Carondelet Foundry Company,
St. Louis, Missouri

"Our *Lectromelt** Furnace gives us the Versatility needed in our jobbing foundry"

"Top-charging doesn't give our Lectromelt Furnace much time to loaf, boosting its productive time and holding down labor costs," reports Carondelet Foundry Company.

"Its versatility lets us shift easily from one type product to another . . . from high strength gray irons for pressure castings, to special steels for heat resistance, corrosion and abrasion resistance. In 10 minutes we make a spectrographic, prepouring

analysis, permitting us to adjust each heat to meet specifications.

"Our Lectromelt Furnace is new, but already it's proved its worth."

If your business involves melting, smelting, refining or reduction, it will pay you to investigate what Lectromelt Furnace Equipment will do for you. For Catalog No. 9, write: Pittsburgh Lectromelt Furnace Corporation, 316 32nd Street, Pittsburgh 30, Pa.

Manufactured in . . . CANADA: Lectromelt Furnaces of Canada, Ltd., Toronto 2 . . . ENGLAND: Birlec, Ltd., Birmingham . . . FRANCE: Stein et Raubaix, Paris . . . BELGIUM: S. A. Belge Stein et Raubaix, Bressoux-Liege . . . SPAIN: General Electrica Espanola, Bilbao . . . ITALY: Forni Stein, Genoa. JAPAN: Daido Steel Co., Ltd., Nagoya

MOORE RAPID

WHEN YOU MELT...

Lectromelt

*REG. T. M. U. S. PAT. OFF.



WRITE FOR YOUR COPY



of FEDERAL'S
useful **BULLETIN**
on the preparation
of "tailor-made"
molding sands

If you have not already done so, you really should send for this bulletin, for hundreds of foundrymen have found it to be extremely helpful in the preparation of molding sands.

It explains in detail the seacoal-bentonite-stabilizer method of sand preparation. It fully describes the three additives—the properties they provide for sand mixtures—how to use them—and suggests a variety of sand mixtures for different types of castings.

An overwhelming majority of iron foundries now use this method of sand preparation. It is thoroughly dependable, produces excellent castings, does *not* require close sand control and . . . the three additives actually cost *less than \$1.00 per ton of castings produced.*

Therefore, if you're using any other method of sand preparation—using other materials that cost more and require exacting sand control—then investigate this *better* method. Write for FEDERAL's Molding Sand Bulletin . . . NOW!

DUSTLESS

SEACOAL and PITCH BINDERS

CROWN HILL SEACOAL AND FEDERAL PITCH BINDERS now come in the new "dustless" grades as well as regular. They're chemically treated to minimize dustiness in handling. The slight additional cost is more than offset by more healthful working conditions, better "housekeeping" and the elimination of losses in air-swept mixing and handling equipment. Ask your FEDERAL representative to demonstrate the new "dustless" additives.

FEDERAL



Make your foundry a better place in which to work!

The FEDERAL FOUNDRY SUPPLY Company

4600 EAST 71st STREET, CLEVELAND 5, OHIO

CROWN HILL • W. VA. • CHICAGO • MILWAUKEE • RICHMOND, VA. • ST. LOUIS • CHATTANOOGA • NEW YORK • UPTON, WYO.
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Costs on CHARGING and MELTING

The Down
Expense

this major producer* of castings has planned well with MODERN engineers in the synchronization of every handling operation:

*Lokey Foundry Corporation, Muskegon, Michigan is a major producer of grey iron castings for the automotive, agricultural and household appliance industries.

The 165 cu. ft., self-tripping bucket conveys coke and stone, by crane, from car unloader to bin and batch larry. Scrap and pig are charged directly into the weigh hopper.

All components flow mechanically from gondola cars, through MODERN 108" cupolas, to the molds on the pouring floor. Undercar unloaders . . . coke and stone buckets . . . bins . . . hoppers . . . scales . . . MODERN Small-Cone charging bucket . . . inclined-swivel charger and the melting equipment team together to pull down costs while boosting the over-all quality.

Much of this controlled, time-proved mechanization is described in bulletin S-147-B. A note on your letterhead will start our thinking about ways to cut your costs RIGHT NOW while we're planning together for tomorrow's expansion . . .



EQUIPMENT COMPANY
Port Washington, Wisconsin

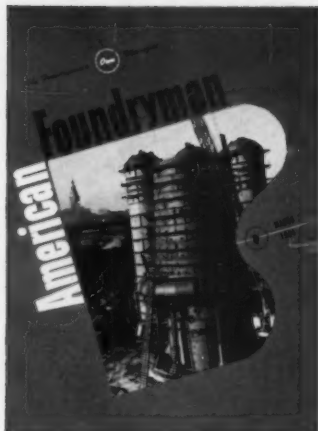
American Foundryman

Volume 25

March 1954

Number 3

Published by American Foundrymen's Society



American Steel & Wire Div. of U. S. Steel Corp. is building this 229-ft blast furnace only short distance from downtown Cleveland. Rising in three cylindrical sections behind the furnace are the 114-ft heating stoves. The installation will supply merchant pig iron to the northeastern Ohio area, one of the most active metals processing regions in the nation, and site of the 1954 AFS Convention and Foundry Exhibit.

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with

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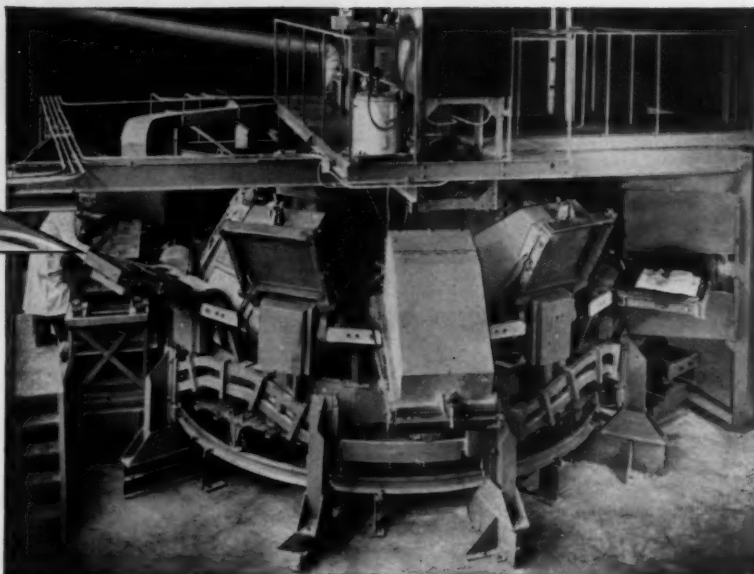
Please send me ☐ Free sample of Dow Corning 8 Emulsion
☐ Data on Silicone Release Agents for the Shell Process

Name

Company

Street

City Zone State



Automatic from sand-resin blending to the finished molds, the 12-station shell mold machine developed and built by Mechanical Handling Systems, Inc., of Detroit, is capable of producing 480 shells per hour. Only a single operator is required. The machine rotates counterclockwise through pattern spraying, sand-resin application, curing, and finished shell delivery. An automatic proportioning system for sand, resin and wetting agent is located at the top of the machine.

**... the Silicone Parting Agent that
gives you clean, positive release of
shell molds and cores at lowest cost**

The more use you make of the shell process, the more continuous your production of clean, accurate shells must be. That's why leaders in this new field specify Dow Corning 8 Emulsion as their parting agent. Equally effective in manual or automatic equipment, this non-corrosive, nonflammable silicone emulsion assures peak production every working day.

That's because Dow Corning 8 Emulsion provides easy release at molding temperatures and will not break down to form a carbonaceous deposit on pattern plates. Nonsticking and nongumming, it keeps patterns cleaner longer and cuts your maintenance costs to the minimum.

Easily diluted in hard or soft water, Dow Corning 8 Emulsion is available at a price some 8% below that of earlier silicone emulsions. It is highly resistant to creaming in storage or after dilution. For lower costs, longer service and positive release, specify Dow Corning 8 Emulsion. Try it yourself at our expense. Send for your FREE trial sample today.

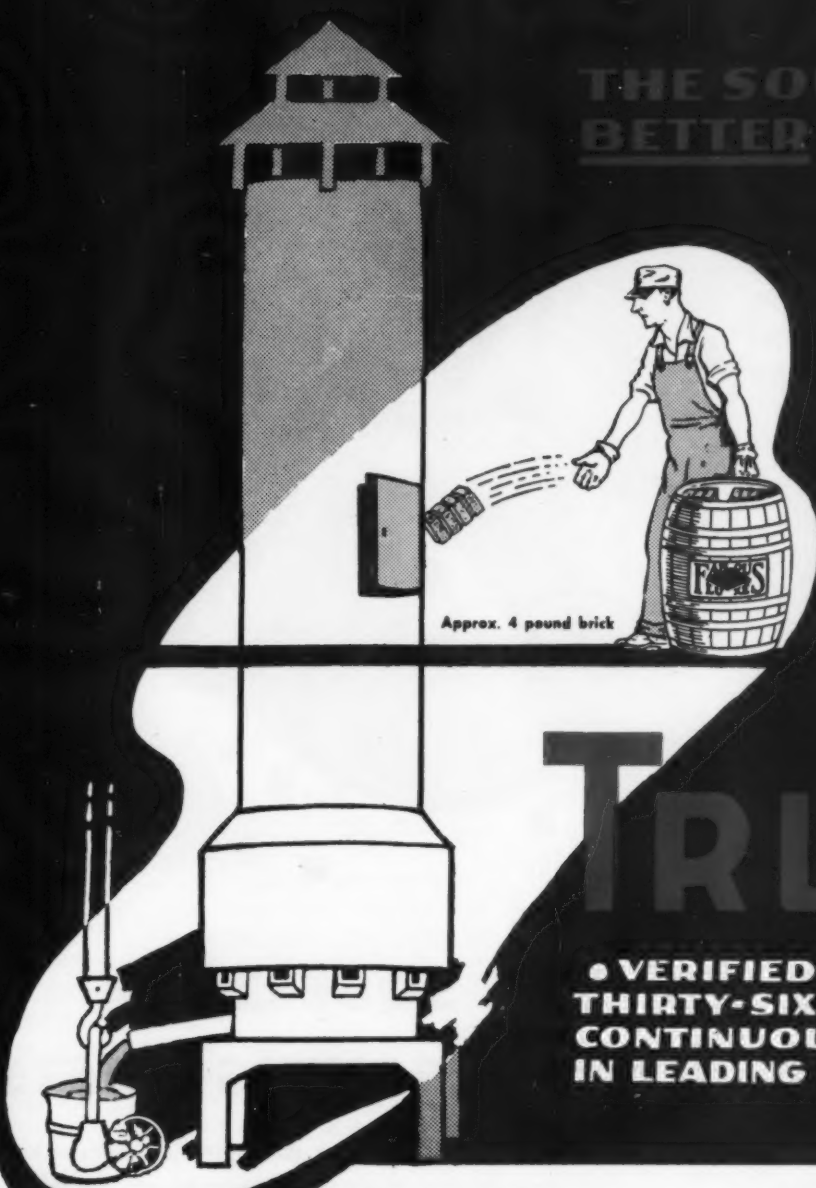
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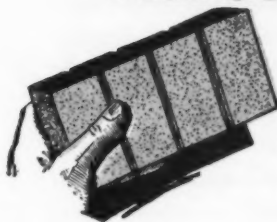
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• VERIFIED BY OVER
THIRTY-SIX YEARS OF
CONTINUOUS SUCCESS
IN LEADING FOUNDRIES.

Famous CORNELL CUPOLA FLUX

MOLTEN IRON CLEANSER in PRE-MEASURED SCORED BRICK FORM



Famous Cornell Cupola Flux purifies the molten iron in the cupola and increases its fluidity. Sulphur is greatly reduced (many times to practically nothing) and slag is kept fluid. Castings come sounder, cleaner — hard spots, hollow centers are greatly reduced, machining is easier and smoother.

Famous Cornell Cupola Flux not only pays off through improved quality of molten iron, the cupolas are kept cleaner and a great amount of digging out is eliminated. And a glazed or vitrified protective surface is formed on brick or stone lining, minimizing erosion and repairs. Write for Bulletin No. 46-B

The Cleveland Flux Co.

1026-1040 MAIN AVENUE, N. W., CLEVELAND 13, OHIO

Manufacturers of Iron, Semi-Steel, Malleable, Brass,
Bronze, Aluminum and Ladle Fluxes — Since 1918



Trade Mark Registered

**BRASS
FLUX**

FAMOUS CORNELL BRASS FLUX cleanses molten brass even when the dirtiest brass turnings or sweepings are used. You pour clean, strong castings which withstand high pressure tests and take a beautiful finish. The use of this flux saves considerable tin and other metals, and keeps crucible and furnace linings cleaner, adds to lining life and reduces maintenance.

**ALUMINUM
FLUX**

FAMOUS CORNELL ALUMINUM FLUX cleanses molten aluminum so that you pour clean, tough castings. No spongy or porous spots even when more scrap is used. Thinner yet stronger sections can be poured. Castings take a higher polish. Exclusive formula reduces obnoxious gases, improves working conditions. Brass contains no metal after this flux is used.



HOW TO PUT THE SQUEEZE ON BLAST CLEANING COSTS



... **USE MALLEABRASIVE, SHOT OR GRIT.** Scientifically heat-treated for durability, Malleabrasive lasts longer. Laboratory controlled for strength and consistency, Malleabrasive cleans better faster. And because it does a better job in less time with fewer refills, Malleabrasive cleans *cheaper!* See for yourself. Next time you order blast cleaning abrasive, specify Malleabrasive from Pangborn Corp., 1300 Pangborn Blvd., Hagerstown, Maryland.

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U. S. Patent # 2184926
(other patents pending)

VOLCLAY BENTONITE

NEWS LETTER No. 36

REPORTING NEWS AND DEVELOPMENTS IN THE FOUNDRY USE OF BENTONITE

We, too, are Interested in Your Casting Finish . . .

Many things make for better casting finish and surface, but the sand grain is the most important factor. The finer the base sand selected, the better the texture of the casting. Finer base sand is the "key" to better and closer tolerances.

Every foundryman knows, all too well, how quick the public is to accept a new process simply because it is "new".

From time to time a new process will claim better finish, closer tolerances, lower costs, better molding conditions, etc. It is not the process that makes for better castings and better casting finish, but the control, supervision, method, and the base materials which are incorporated in the molding mixture.

Casting finish is dependent upon the base sand which is selected for use. A coarse base sand does not furnish a good casting finish. A coarse base sand requires many fines to fill the voids to prevent the metal from penetrating during casting. These additives are expensive.

Such additives are more expensive than a finer base sand, therefore, the finer base sand should be considered before adding other ingredients to obtain better casting surface finish.

If a process states that it, and it alone, is responsible for better casting finish, it is then time to study the raw materials which are required in the recommended mixture and certainly the fineness of the sand which is recommended for that process.

When making a comparison between a present proc-

ROUGH FINISH

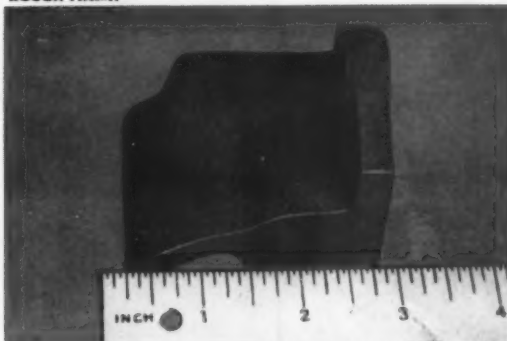


Photo compliments of J. R. Nicholas

ess and a "new" process, always compare "like to like and equal to equal". The economics of the new vs. the old can be evaluated on this basis only.

Molding base sands with a distribution over 4, 5, or even 6 adjacent sieves are claimed to be much better than the customary uniform, two or three-screen sand. A bond selected should be one where a minimum amount can be used, thus allowing a minimum amount of temper water in the mixture. This bond must allow flowability in order for the mixture to ram and jolt firmly around the pattern. PANTHER CREEK Southern bentonite is such a bond.

To properly satisfy casting customers today, the foundrymen must give more attention to casting finish. Companies producing die castings, permanent mold castings, investment castings, and others sell castings on appearance and almost to a machine finish.

Closer tolerances, surface finish, dimension size, are directly related to molding sand properties and methods. Foundry progress can be advanced considerably, making the most of what we already have, by utilizing a finer base sand to give this finish and not rely on imaginative claims of new processes.

**There is no substitute for know-how, supervision,
closer control, and the urge to do better.**

AMERICAN COLLOID COMPANY

CHICAGO 54, ILLINOIS

Producers of Volclay and Panther Creek Bentonite



Time is of the essence... when processing incoming foundry orders!

Although considerable study has been devoted to the cost of labor essential to the productive phase of order filling . . . *little thought has been given to the clerical costs involved.* Therefore, the margin of profit anticipated in the quotation and actually produced in the shop mysteriously disappears by the time the customer has been invoiced.

is your ratio of office workers to shop productive workers disproportionate?

Only an OFFICE SURVEY will provide a factual answer to this question. This service consists of—analysis of all office procedure to study the possibility of elimination—combining operations by hand or by machinery to reduce duplication of effort and cost of printed forms—counseling on initial investment for modern machines in relation to ultimate savings.

we have effected savings of up to 50% in personnel costs in some foundries and additionally, have reduced their printing overhead.

Remember—a minute saved on a clerk at \$50 per week is \$.025—the minute saved on an executive at \$10,000 per year is \$.10 plus \$.025—add 100% overhead and it becomes \$.25 per minute.

Westover Engineers have helped scores of Foundries throughout the United States and Canada to solve their problems . . . cost . . . pricing . . . production . . . labor relations and plant management. You can discuss your problems with us without obligation.

Write today for full information



Westover

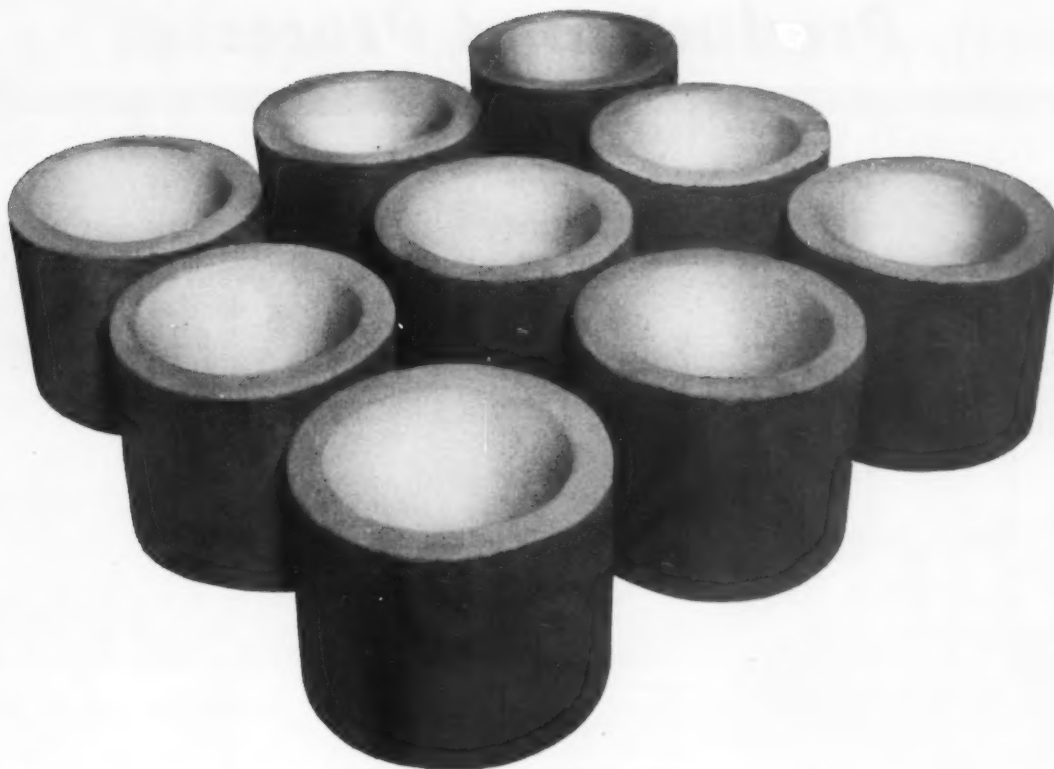
ENGINEERS

FOUNDRY MANAGEMENT CONSULTANTS

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PHONE CUSTER 3-2121

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How to increase core production of your present equipment: ... use RESINOX 4846 core binder

You can cut core baking time 35% to 40%, compared to oil-bonded cores... increase the capacity of your core baking equipment... and get faster, more efficient production, with Monsanto's phenolic core binding resin, Resinox 4846.

This outstanding resin offers these advantages:

1. Remarkably lower fuel consumption per ton of cores baked.
2. Reduction in scrap during handling and storage.

3. Higher baked tensile strength and core hardness.
4. Smoother surfaces; better detail and dimensional accuracy.
5. Lower gas content and lower rate of evolution.

You'll want to investigate Resinox 4846, as well as Monsanto's urea core binders, and the whole series of resins available for shell molding; also Lytron, a new sand conditioner for foundry use. Just use the handy coupon today.

Resinox, Lytron: Reg. U. S. Pat. Off.

LOOK FIRST TO MONSANTO FOR THE LATEST RESEARCH-BUILT, SHOP-TESTED FOUNDRY RESINS



SERVING INDUSTRY . . . WHICH SERVES MANKIND



MONSANTO CHEMICAL COMPANY, Plastics Division, Room 5603, Springfield 2, Mass.

Please send me complete information on:

- ☐ Resinox 4846 phenolic core binder; ☐ Other Monsanto core binding resins;
☐ Resins for shell molding; ☐ Lytron sand conditioner.

Name & Title _____

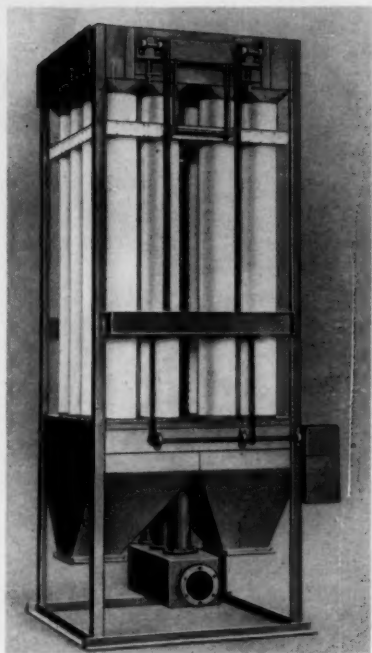
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City, Zone, State _____

Products and Processes

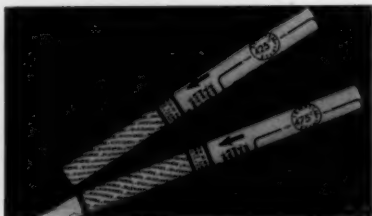
continued on page 12



Dust Collector

Newly developed AMERjet dust collector is a reverse jet fabric collector designed for those applications where extremely fine particles are involved or where the material must be collected in a dry state for reclaiming. Cleaning media is automatically reconditioned by a jet of high pressure air forced through the cloth in opposite direction to the flow of the air being cleaned. *American Air Filter Co.*

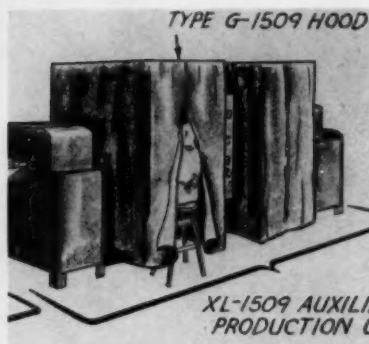
For more data, circle No. 133, p. 17



Temperature Ratings

New temperature rating Tempilstika® are now available for 425F and 475F. Others now available are in range 113F to 400F in 12½F intervals, in the range 400F to 500F in 25F steps, and in 50F intervals from 600F to 2000F. *Tempil Corp.*

For more data, circle No. 134, p. 17



Industrial Inspection

Increased inspection rates can be achieved at low cost, on existing facilities without obsoleting any other equipment, it is claimed, by use of a new conveyorized Auxiliary Production Unit which works for small to medium parts, in conjunction with any standard stationary Magnaflux unit. With the addition of the new unit it is pointed out, one operator can supply either two or four inspectors. *Magnaflux Corp.*

For more data, circle No. 135, p. 17



Gravity-Fed Hopper

Press operator picks parts from work-level tray of compact Work-O-Matic Gravity-Fed Hopper, designed for mass material supply in crowded work areas. At right, fork truck operator drop-bottom dumps more parts into the hopper. The compact, portable hopper has a volume of 34.8 cu ft but occupies no more floor space than a conventional industrial container, it is claimed. Both box and hopper are made by *Union Metal Manufacturing Co.*

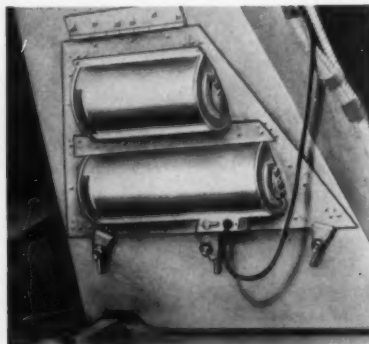
For more data, circle No. 136, p. 17



Tractor Shovel

New one cu yd capacity tractor shovel, is available in three models: 75-A, four-wheel drive with rear wheel steering; 75-B, bucket drive with rear wheel steering; and 75-R, rear wheel drive with bucket steering. Tractor shovels are being produced in six different models ranging in capacity from 15 cu ft to ½ cu yd. *Clark Equipment Co.*

For more data, circle No. 137, p. 17



Warning System

New control, Magnalarm, gives foundries protection by preventing overloading permanent magnetic separators which eliminate machine damage and product contamination. Unit, by means of a sensitive ferrometer, constantly measures the quantity of tramp iron as it accumulates on magnet's surface, and reacts on a circuit to trip the alarm as soon as a predetermined accumulation is reached. *Eriez Manufacturing Co.*

For more data, circle No. 138, p. 17

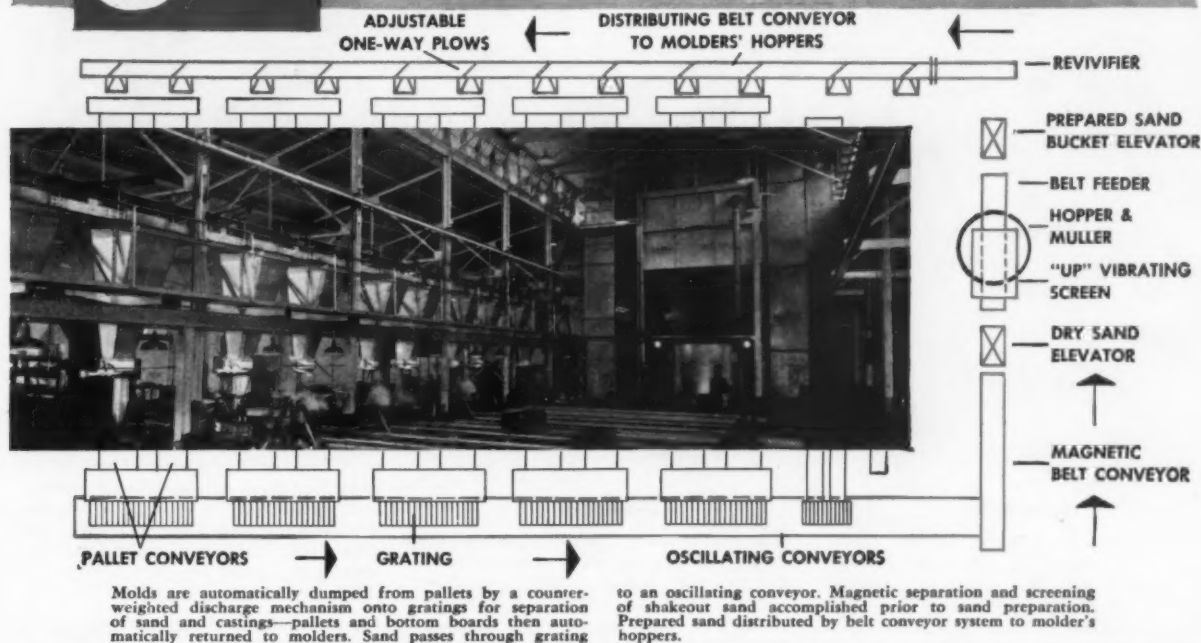
Vibrating Feeder

New vibrating feeder that operates at near-resonant frequencies is now available. Feeder has wide operating range, it is claimed, being capable of turning out from 0.1 to 20 cu ft of product per minute. *Richardson Scale Co.*

For more data, circle No. 139, p. 17

3rd

M-M sand handling system mechanized by Link-Belt



Minneapolis-Moline modernizes for better castings at lower cost

WHEN you mechanize your foundry, you can be *sure* it will pay off. And when Link-Belt does the engineering, you're doubly sure.

Witness the experience of Minneapolis-Moline Co. Several years ago they called in Link-Belt to modernize a light casting foundry. Two years later they wanted to step up production of heavy castings. Again Link-Belt was consulted.

Now, for the third time, Link-Belt has served Minneapolis-Moline. Their new sand handling system adds efficiency, improves working conditions, makes possible better castings at lower cost.

If you're contemplating a new foundry—or modernization of existing facilities—call in a Link-Belt foundry engineer. He'll work with you—help you obtain the best layout and equipment for your requirements, whether your foundry is large or small.

LINK-BELT

CONVEYORS and PREPARATION MACHINERY



In a tunnel under shakeout grates, two Link-Belt Oscillating Conveyors collect hot sand. All-metal construction, with leak-proof troughs, makes these conveyors ideal for foundry duty.

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.



Products & Processes

For additional information,
use postcard at bottom of page 17

continued on page 17



Speed Balance

Semi-automatic balance recently introduced claims faster weighing with greater convenience. The No. 240 Speed Balance has a deflection scale reading up to ten gm, a capacity of 1,000 gm and a sensitivity of 20 mgm. Direct moisture scale is provided for greater speed in the determination of moisture with the Moisture Teller of oven. *Harry W. Dietert Co.*

For more data, circle No. 140, p. 17



Black Light

New high powered black light ultra violet inspection lamp has 100 watt sealed beam mercury arc reflector bulb and 5-in. roundel filter enclosed in a streamlined glass-fibre reinforced phenolic housing. May be either hand held or selectively mounted and directed by placing on special universal swivel atop the base. *Burton Manufacturing Co.*

For more data, circle No. 142, p. 17



Centralized Lubrication

Industrial trucks equipped with Lincoln Engineering Company's "Centro-Matic" centralized lubrication system are now available. Major advantages of the system, it is stated, include complete and thorough lubrication of the truck with a minimum of effort and time. Maintenance is reduced since one man can do the job. System permits application of grease to any number of points. Injector for each point is connected to the bearings by a tube and receives its supply of grease under pressure from the central pumping unit. *Elwell-Parker Electric Co.*

For more data, circle No. 141, p. 17



New Model Payloader

Refinements and modifications of the new model TC-60 Payloader towing tractor, which contribute to greater ease of control, convenience and usefulness, have been added, it is claimed, without sacrificing basic features such as compactness of design, maneuverability and a drawbar pull of 6,000 lb. Dual-range, full-reversing transmission has been provided with a solenoid vacuum-actuated tail-shaft brake which stops rotation of the transmission while shifting and enables the gears to mesh quickly and quietly. *Frank G. Hough Co.*

For more data, circle No. 143, p. 17



Testing Machine

Highlight of a production model Brinell Hardness Testing Machine, designed to fit directly into a conveyor system, is a roller conveyor arranged in conjunction with the anvil of the tester. The machine, designated Model KDR-10X, is motor driven hydraulically operated. *Steel City Testing Machines, Inc.*

For more data, circle No. 144, p. 17



Automatic Wet-Blaster

Known as the Pressure Blast Roto-Matic, this new concept in wet-blasting equipment reportedly was designed for the elimination of hand filing, grinding, wire brushing and chemical cleaning of small metal parts. In operation, operator is seated at front of unit and loads and unloads work-pieces from rotating table which incorporates appropriate work holding fixtures. *Cro-Plate Co.*

For more data, circle No. 145, p. 17

**SAVE ALL THE
WAY WITH
NATIONAL
TRADE-MARK
CARBON BLAST
FURNACE LININGS**

Record operating economies — so outstandingly established by "National" carbon in blast furnace hearths—*needn't stop there!* Now you can get the same advantages — longer life, lower maintenance, smoother operation—with carbon linings in blast furnace walls, in tuyere and in bosch sections.

Present day economics indicate now, more than ever, a need for carbon "all the way". Let's talk it over in terms of *your* operation!

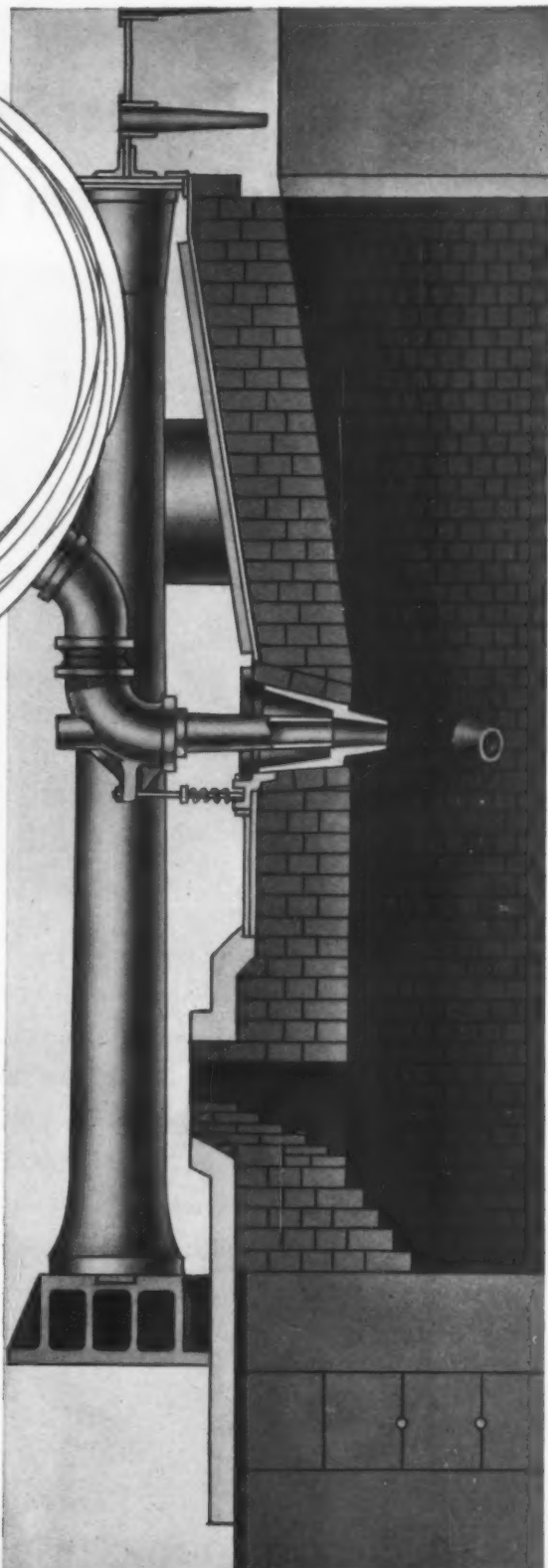
The term "National" is a registered trade-mark of Union Carbide and Carbon Corporation

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· HEAT EXCHANGERS AND PUMPS · BRUSHES FOR MOTORS AND GENERATORS





Another Shipment of Sterling Rolled Steel Flasks for Uncle Sam!



Part of an order of 504 Sterling Flask Sections shipped to a West Coast Governmental Agency.

IT'S significant that Sterling Rolled Steel Flasks are frequently specified by U.S. Governmental Agencies. Sterling Flasks last longer, cost less in the long run. They are fabricated from special hot rolled steel channel — *not merely pressed steel*. The heavy flanges, with square corners and full-width bearing, and the solid angle reinforcing welded around each section, provide strength and rigidity to withstand tremendous pressures, year after year. Partings are accurately machined and the thick flanges have plenty of steel for several refinishings.

Get all the facts! Write today for your copy of Sterling Flask Catalog.



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STERLING FOUNDRY SPECIALTIES, LTD.
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Manufacturers of Foundry Equipment for Almost Half a Century



Sterling Equipment for Your Foundry

Standard Flasks • Heavy Duty Flasks • Stack Molding Flasks • Flask Pins • Hardened Steel Bushings • Steel Pins • Collar Bushings • Malleable Clamps • Steel Bottom Boards • Steel Core Plates • Squeeze-in Boards • Steel Bands • Steel Upsets • Wheelbarrows • Core Trucks • Casting Trucks • Slag Buggies • Casting Carts • Steel Wheels • Casters.

It's easy to fit
core formulations
to casting conditions with
**FOUNDREZ
7600**

Using RCI's liquid, water-soluble, thermosetting, urea-formaldehyde resin — FOUNDREZ 7600 — as a sand binder, you can easily develop the core mix that's best and most economical for your casting metal, oven capacity and production rate.

FOUNDREZ 7600 is flexible. It permits variation of such properties as green strength, collapsibility, permeability and hardness in a wide range of core formulations for copper, brass, bronze, aluminum, magnesium, gray iron, cast iron and steel alloy castings. Moreover, this stable resin speeds baking, an advantage you can use either for faster production or fuel savings.

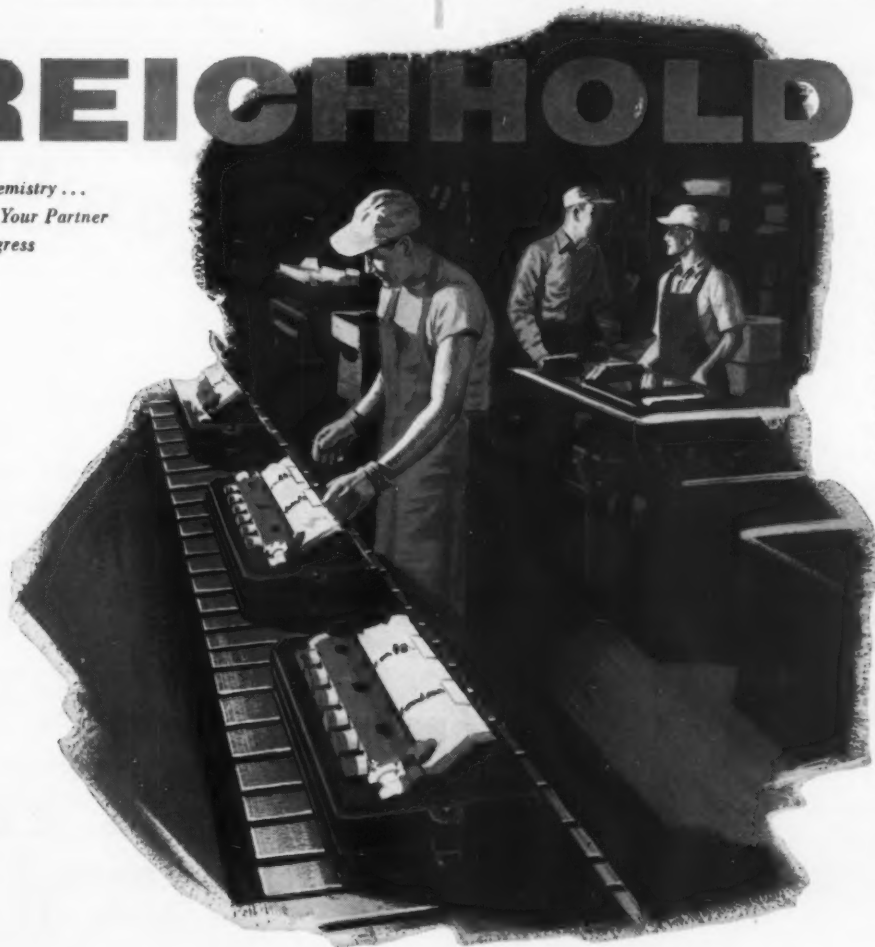
For full data at no obligation, write for Technical Bulletin F-2. RCI's Foundry Technical Service is available to help create the mix most suited to your purpose.

REICHOLD CHEMICALS, INC. 525 NORTH BROADWAY, WHITE PLAINS, N. Y.

REICHOLD



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Your Partner
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Synthetic Resins
Chemical Colors
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Sodium Sulfate
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FOR A
Quick
SURFACE-METAL
SET . . .

**DELTA
Z-KOAT and
Z-Z-KOAT**

CORE AND MOLD WASHES

Contain
ZIRCONIUM

DELTA Z-KOAT and Z-Z-KOAT Washes are easy to mix and easier to apply. After mixing, there is no danger of precipitation and, when dry, are completely moisture-proof. Applied by swabbing, dipping or brushing they adhere uniformly to the sand and produce smooth, highly-refractory surfaces.

Both DELTA Z-KOAT and Z-Z-KOAT Washes have unusually high fusion points and, because of their high heat conductivity, provide a more rapid surface-metal set. Both washes are economical to use.

DELTA Z-KOAT contains zirconium plus other high fusion refractories and DELTA Z-Z-KOAT is an all-zirconium type wash.

Working samples together with instructions available on request.

DELTA
OIL PRODUCTS CO.
MILWAUKEE 9, WISCONSIN

MANUFACTURERS OF SCIENTIFICALLY CONTROLLED FOUNDRY PRODUCTS

Products & Processes

Continued from page 12

CONVENIENT FORM FOR ORDERING INFORMATION

Silicones

Three silicones, specially designed as shell mold release agents, are now available. LE-46, Silicone Parting Emulsion, is a stable emulsion stock; LS-46 Silicone Parting Solution, is a ready to use solution; and L-46, Modified Silicone Stock, is for users who prefer to make up parting solutions in their own plant. *Linde Air Co., a Div. of Union Carbide and Carbon Corp.*

For more data, circle No. 146 on card

Electronic Controllers

A new line of electronic controllers for automatic testing production and research testing programs has been developed. These accessory units were developed for use in conjunction with all standard testing machines, new or old, wherever practical. *Tinius Olsen Testing Machine Co.*

For more data, circle No. 147 on card

Welding Rod

Oxy-acetylene welding rod for cast iron, applied without fusion of the base metal, that combines dense welds and high tensile strength together with better appearance, has been developed and is known as EutecRod 143 FC. Flux coated rod, also available bare, contains special alloying elements for greater strength and denseness of weld, it is claimed. *Eutectic Welding Alloys Corp.*

For more data, circle No. 148 on card

Portable Dust Bin

Portable dust bin is available as optional equipment for Model 219 Twin Cyclone Dust Separator. It is intended for use where large volumes of dust require frequent emptying of the dust reservoir for disposal or salvage. According to manufacturer this portable dust bin materially reduces the down time required to change dust bins. *Torit Manufacturing Co.*

For more data, circle No. 149 on card

Profile Template

A 12 in. AJUSTO Profile Template uses brass strips .010 in. thickness, it is claimed. Both a male and female profile are obtained of objects 12 in. long and 4 in. depth of contour. Additional adjustment and locking force has been incorporated by using a right and left hand threaded member to apply pressure on

both ends at once. *Toolcraft Manufacturing Co.*

For more data, circle No. 150 on card

Height Gage

An improvement on the Vernier Height Gage consists in a base slotted in front to allow the short solid jaw with straight scribing point to reach down to the surface plate used. A further improvement has been added by radical change in vernier reading. A Vernier 2.450 in. long, divided into 50 lines, extends over 49 graduations of .050 each on the main scale. This, it is pointed out, makes the

Fill out postcard below for complete information on products listed in these pages.

difference in division of the vernier and main scale large enough to read 1/1000 in. with the naked eye. *George Scheer Co., Inc.*

For more data, circle No. 151 on card

Heat Resistant Paint

Two new colors in heat resistant paints, metallic red and metallic blue, are announced. Manufacturer states that HEAT-REM, which is made of aluminum flakes, is a silicone base, can be applied by either brush or spray gun, and will "air dry" in approximately 30 minutes. It is reputed to prevent rust, resist corrosion from mild acids, alkalies and industrial fumes, and expand and contract with temperature changes. *Speco, Inc.*

For more data, circle No. 152 on card

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54/3

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AMERICAN FOUNDRYMAN

616 S. Michigan Avenue

Chicago 5, Illinois

Free Foundry Information

For additional information

use postcard at bottom of this page

Sand Reclamation

Two papers presented at the 57th Annual Meeting of the American Foundrymen's Society in Chicago have been incorporated in a booklet entitled "Sand Reclamation." Papers included are: "A Wet Method of Sand Reclamation" by P. C. Will and R. H. Shurmer; and "Sand Reclamation in a Steel Foundry" by H. H. Johnson, R. Y. McCleery and G. A. Fisher.—*Hydro-Blast Corp.*

For more data, circle No. 153 on card

Autotrator

Bulletin B-223 describes Model 19 Autotrator which is an inexpensive accessory

for pH Electrometer Model 18, manufactured by *Coleman Instruments, Inc.*

For more data, circle No. 154 on card

Casting Impregnation

Booklet on casting impregnation entitled, "You Remove the Stigma From Casting Impregnation When You Use the Polyplastax Way," places emphasis on the reference that the use of an impregnation system to assure density and increase the pressure tightness of castings is not a method of salvage of inferior or defective units. *Polyplastax International, Inc.*

For more data, circle No. 155 on card

Variable Speed Drives

Folder 2374 provides detailed information on the size 6 P.I.V., positive, infinitely variable speed drives, in its three types and many ratios and assemblies. *Link-Belt Co.*

For more data, circle No. 156 on card

Electric Heat

Principal industrial electric heating applications and methods are described in booklet F 1550, "101 Ways to Apply Electric Heat." Treatment is given to problems of heating air and gasses; melting soft metals and viscous materials. *Edwin L. Wiegand Co.*

For more data, circle No. 157 on card

Castings of Titanium

Brochure describing the development of a process for the manufacture of castings of titanium and titanium alloys with the plan to grant nonexclusive licenses on the process, is now available. Responsible individuals should request brochure on business letterheads. *Development Dept., National Research Corp.*

For more data, circle No. 158 on card

Fork Truck

A 2,000 lb capacity fork truck, designed for fast tiering and available in two models is described in a four-page folder issued by *Ewell-Parker Electric Co.*

For more data, circle No. 159 on card

Gray Cast Irons

Bulletin A-174, "Development and Control of Engineering Gray Cast Irons," contains 52 pages, 35 photomicrographs, charts and tables. Explaining how to control both the graphite and matrix structure of gray cast iron so as to obtain superior mechanical properties. *International Nickel Co., Inc.*

For more data, circle No. 160 on card

Refractories

Bulletin 103, *Ironton Steel High Duty Dry Press Fire Brick*, points out specific applications for its use and includes diagrams indicating proper locations. Bulletin 104 presents ten new refractory insulating concretes that can be mixed and cast in place for 20 typical heat-saving applications. *Ironton Fire Brick Co.*

For more data, circle No. 161 on card

Cut Wire Shot

Technical Bulletin No. 7 describes Cut Wire Shot, its development and use. Chart shows specifications for nine different sizes. *Harrison Abrasive Div., Metals Disintegrating Co., Inc.*

For more data, circle No. 162 on card

continued on page 88

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CITY AND ZONE



**every study shows a
handling saving**

80 TONS OF SUGAR PER DAY

SAVES \$30 ON EVERY CAR UNLOADED

RETURNS 84% OF ITS COST

Many companies are checking their handling problems against the American MonoRail Case Study File of "Engineered Applications." The file contains a series of case studies taken from many successful American MonoRail installations. One company saved \$30.00 on every car unloaded. Another doubled metal finish production. A glass plant moved 22 tons of glass batch per hour. Another installation returned 84% of its cost in one year. These are just a few of the many studies covered.

If you want to lower your handling costs, speed up production and cut maintenance overhead, let us send you this file. Just drop us a line on your business letterhead, asking for "Engineered Applications File F-1."



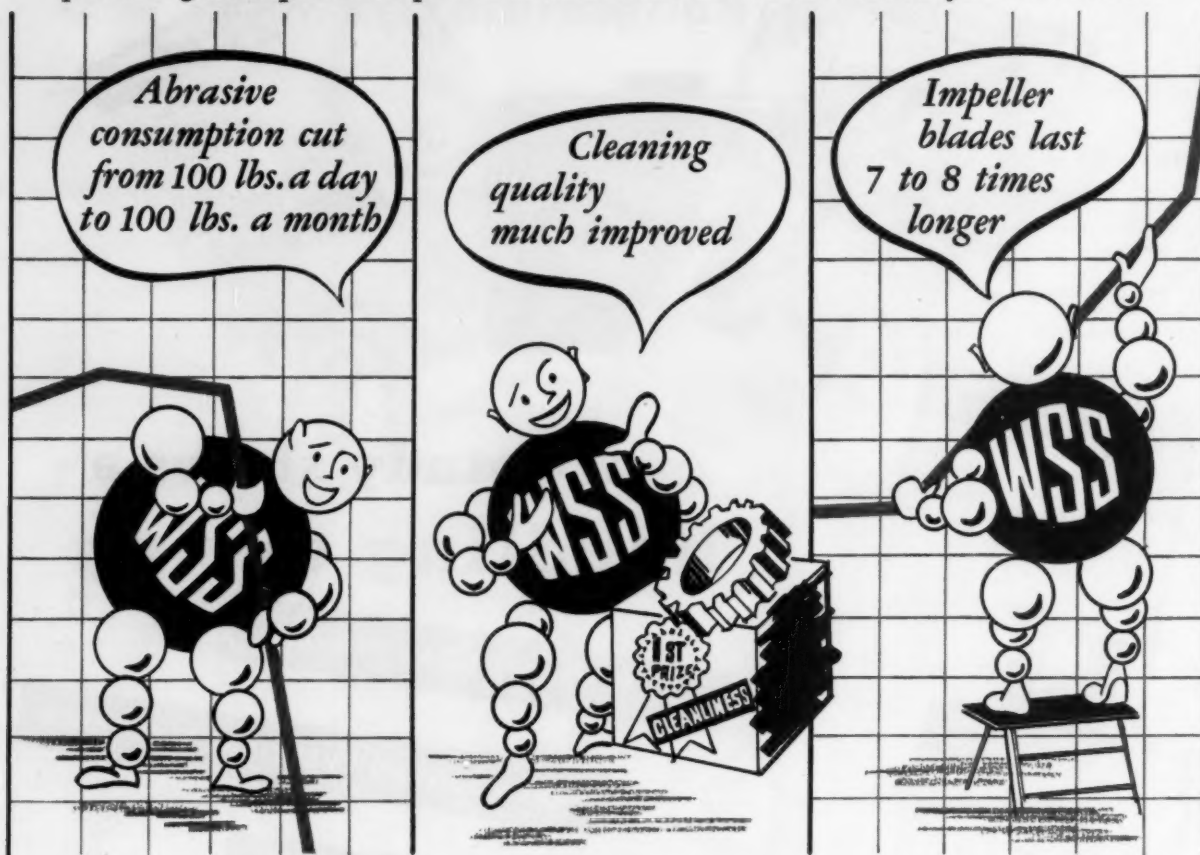
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MonoRail COMPANY

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triple savings result from use of **WHEELABRATOR STEEL SHOT**

at the **FATE-ROOT-HEATH COMPANY**

Thirty times longer shot life, 8 times longer life for blast machine parts and much improved cleaning quality have resulted at the Fate-Root-Heath Company since they switched to Wheelabrator Steel Shot. Whereas they formerly added 100 to 200 pounds of chilled iron shot every day to the machine . . . they now add about 100 pounds a month of Wheelabrator Steel Shot.

In addition, wheel blades now last 4 to 5 weeks compared to

only 3 days with the chilled shot.

The Wheelabrator Tumbblast in which this superior shot is being used is operated 7 hours a day, five days a week cleaning gray iron castings weighing from $\frac{1}{4}$ lb. to 300 lbs. each.

Not only does the Wheelabrator Steel Shot last longer and reduce operating costs, it also does a much better job of cleaning. No castings are cleaned more than

five minutes and most are cleaned in a three minute cycle.

"If steel shot cost twice as much as it does, it would still be the cheapest material to use," writes W. L. Chatfield, Foundry Supt.

Similar performance records in plants throughout the country on every type of product prove convincingly that the lowest overall cleaning costs are achieved with Wheelabrator Steel Shot.

Try it today and see.

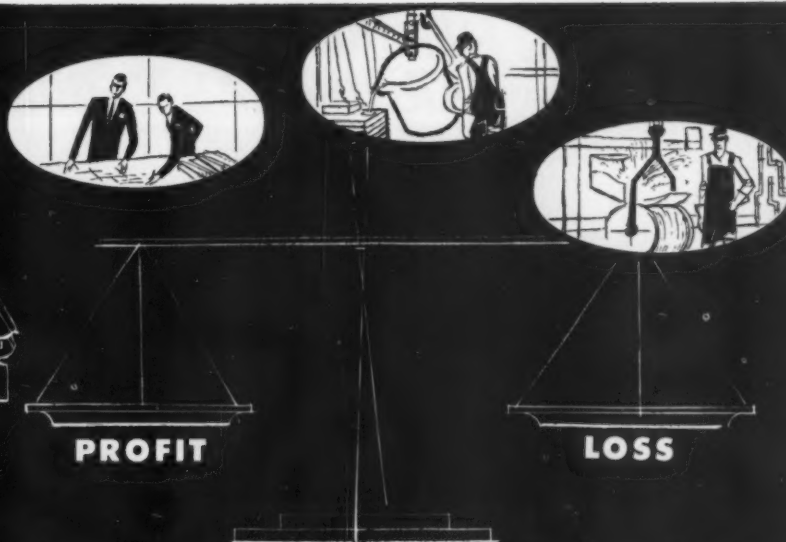


"6 Steps to Greater Abrasive Savings"—a new 8-page Bulletin describes how your abrasive costs can be cut. Send for your copy today.

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Your OPERATING EFFICIENCY WILL control your PROFITS in 1954

In foundry operation, making the best use of facilities and manpower determines the balance between profit and loss.

In many foundries, management and operation audits by experienced Knight engineers have helped to swing the balance to profit—through low-cost, readily effected improvements.

A recent Knight audit for a Michigan foundry resulted in substantial production increases and reduced costs. Improvements included the installation of a conveyor which eliminated handling . . . a rearrangement which increased capacity without additional floor space . . . and automatic timing devices which brought accurate process control and increased production.

These simple low-cost changes, accomplished without interruption to production, are part of a coordinated plan which is designed for future expansion requirements.

If you are interested in an audit of your operations to establish a program of improvement, take advantage of Knight experience and call or write our Chicago or New York office for prompt attention, without obligation.



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 BELONGS IN YOUR
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Photo taken in
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 Elmwood Place, Ohio

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New, Improved PARLEX

another recent technological advancement in

BASE LIQUID PARTING

Where dry parting is indicated, we recommend our

AVON (white) Non Silica Parting

vastly superior to all previous partings of this type.

ONE of our recent laboratory developments — and intended primarily for use as a parting agent in sandslinger operations — *Slinger-slick* will part equally well when sprayed, swabbed or brushed on all types of molding processes: roll overs, squeezers, etc. A base liquid parting, *Slinger-slick* is *unusually economical*. Just add kerosene or other solvent. Saves on material . . . Saves on freight . . . Non-inflammable . . . Not affected by cold . . . Will not settle out . . . Guarantees clean parting, smooth molds. Usually packed in 55 gal. drums. Write on your letterhead for —

1 Gal. Sample FREE. Prove it at our expense. Write today!

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In making a casting specify **PENOLYN CORE OIL**

for assured high efficiency

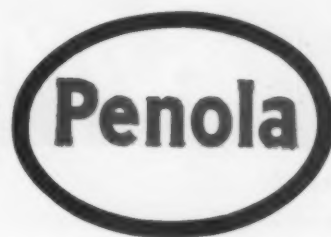
Penolyn Core Oil offers all of these important features for full efficiency

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- No crusting or green mix
- Ample collapsibility

FOR MAXIMUM FOUNDRY EFFICIENCY—always be sure to specify **PENOLYN CORE OIL**. There's a grade of Penolyn to meet the most exacting requirements of every Foundry and Core Room Practice.

FOR EXPERT TECHNICAL ASSISTANCE—always be sure to call the Penola Office nearest to you for any technical data or assistance regarding *your* casting operations.

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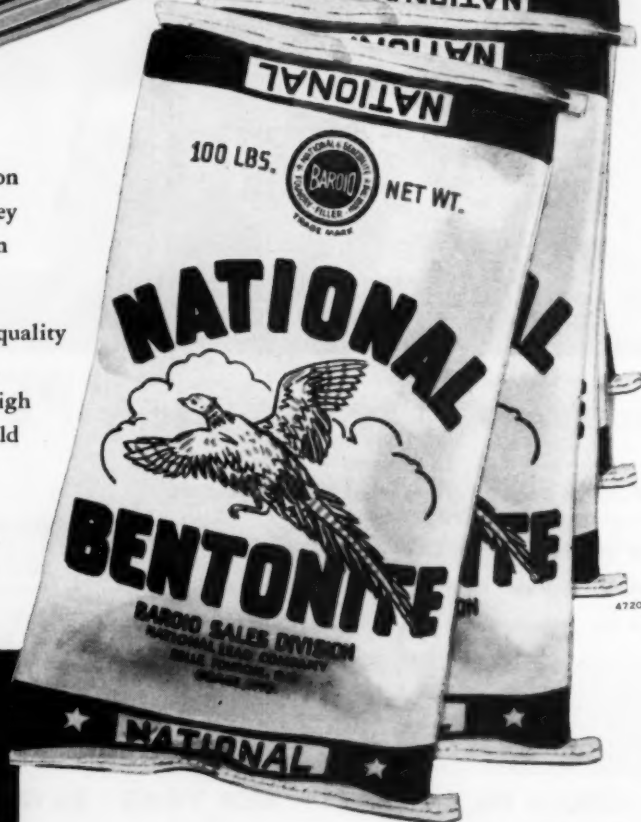
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... Finer finished castings with
NATIONAL BENTONITE bonds!



It's easy to see why many good foundrymen rely on National Bentonite for better bonded molds — they can count on better castings, requiring less time in the cleaning room.

Check these qualities: consistently uniform high quality . . . good green strength . . . high hot strength . . . high tensile strength . . . high permeability . . . high deformation . . . high sintering point . . . good mold durability — and specify National Bentonite for better bonding. It requires less water to temper correctly, too. Use National Bentonite and be sure.



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Bentonite Sales Office: Railway Exchange Building, Chicago 4, Illinois

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Better Foundry Suppliers
Everywhere

ALSiMAG[®] Ceramic STRAINER CORES



SAVE MONEY

RIGHT
DOWN
THE
LINE



ELIMINATE BREAKAGE IN STORING AND HANDLING

ALSiMag Strainer Cores are hard, strong, will stand the roughest handling. They are not affected by moisture, are flat and uniform for fast, easy use. Packed in easy-to-handle cartons for the moulder's convenience.

RESIST POURING SHOCK

ALSiMag Strainer Cores will not erode or fracture under the heat and force of pouring. They are gas-free, not affected by moisture, won't freeze-off the metal. You can depend on ALSiMag Strainer Cores for clean, slag-free castings.

CUT REJECTS AND MACHINING COSTS

Foundries using ALSiMag Strainer Cores have completely eliminated rejects due to core failure. Inclusions, dirty metal, shrink holes and other defects are reduced to minimum. ALSiMag cores always result in more good castings per moulder per hour.

TEST THEM IN YOUR OWN FOUNDRY

Samples of standard sizes free on request. Samples made to your specifications at reasonable cost.

WRITE FOR BULLETIN 532, giving details on ALSiMag Strainer Cores—standard sizes and custom designs—and ALSiMag Cut-off Cores, Troughs, and Gate Tubes.

- 14 STANDARD SIZES
- 2 SPECIAL COMPOSITIONS

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Silicon Briquets



EASY TO HANDLE



EASY TO USE

A new rectangular-shaped briquet for stacking and shipping on pallets is now produced by ELECTROMET. Pallet shipments are convenient and economical to handle. The pallets hold approximately 4,000 lb. of "EM" silicon briquets and are available at no extra charge over bulk shipments. They can easily be unloaded and handled in your plant by lift truck or overhead crane. Handling time and costs are reduced and inventory-taking is simplified. The pallets are expendable and need not be returned.

"EM" palletized silicon briquets are 6 in. x 3 in. x 2 in. in size, weigh 5 lb. gross, and contain 2 lb. of silicon. The briquets are notched, so that they can easily be split in half when 1 lb. additions of silicon are desired. Because they contain an exact amount of silicon, these briquets offer close control of analysis in cupola melting operations.

Phone, wire, or write the nearest ELECTROMET office listed below for further information on how you can save with palletized silicon briquets.

The terms "Electromet" and "EM" are registered trade-marks of Union Carbide and Carbon Corporation.

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TO YOUR COSTLY...
Foundry Problems

Porosity

When you call upon LAVIN'S ENGINEERING SERVICE

Porosity is one of many problems that confront the foundryman.

The evidences as well as the causes of this costly casting defect are numerous. Castings showing center line shrinkage result from pouring too hot. Large holes with a speck of dust in the bottom of each hole are caused by loose sand grains that are entrapped from pouring too cold. Evenly distributed clean bright holes throughout the entire casting are usually caused from excess hydrogen in the metal. Every foundry, at one time or another, encounters casting defects. They could be sand inclusions, shrinkage, slag or flux inclusions, gas porosity, blow holes or one of many others.

LAVIN'S metallurgical staff is always ready to assist the foundryman in finding the solution of any routine or special casting problem. Our chemical and research laboratories are available to you at no cost or obligation in order to find the cause—to offer the remedy.

Next time call upon LAVIN'S engineering service

"The Foundryman's Problems Are Our Problems"



FREE—WRITE FOR YOUR COPY OF THE 8 PAGE LAVINGOT TECHNICAL JOURNAL VOL. 9, NO. 4, CONTAINING A COMPLETE ARTICLE ENTITLED—*"GATES & RISERS FOR MANGANESE BRONZE"*.



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REPRESENTATIVES IN PRINCIPAL CITIES



Foundrymen in the News

Kempton Dunn, first vice-president of American Brake Shoe Co., has been elected president of the organization. He has been with the company since graduat-



Kempton Dunn . . . new president

ing from Yale University in 1932. **Maurice N. Trainer**, president since 1950, has reached retirement age and was appointed to the new post of vice-chairman.

B. A. Miller, superintendent of foundries, Baldwin-Lima-Hamilton Corp., Eddystone Div., Philadelphia, resigned on February 1 to become vice-president and general manager of Crown Non-ferrous Foundry, Chester, Pa. Miller had been with Baldwin for 20 years.

M. Nielsen, vice president, Babcock & Wilcox Co., has been elected to the firm's board of directors and placed in charge of the boiler division.

Grindle Corp. has a new executive assistant to the president with the appointment of **A. J. Van Harn**, who will be in charge of sales and advertising. Mr. Van Harn, formerly of Flint, Mich., has had considerable experience in sales and promotional advertising.



A. J. Van Harn . . . executive asst.



M. N. Trainer . . . retiring

Pangborn Corp. recently welcomed 14 new members to its Quarter Century Club at a banquet in the Hotel Alexander, Hagerstown, Md. New members include: **C. A. Bultman**, Detroit district manager; **W. O. Vedder**, manager, dust control department; **H. C. Trovinger**, shop personnel director; **W. F. Nigh**, chief clerk,



B. A. Miller . . . with Crown

advertising division; **F. D. Diehl**, dust control engineer; **L. B. Kline**, sales; **R. E. Martin**, supervisor; **E. R. Andrews, Sr.**; **D. B. Bachtell**; **E. A. Knott**; **L. C. Morris**; **A. Oberholzer**; **T. W. Ovelman**; and **R. E. Spigler**.

H. H. Richardson and **Dana T. Bartholomew** have been elected to the board of directors and made vice-presidents of Aluminum Ltd.

American Brake Shoe Co.'s export division has announced several appointments. **Harold C. Osborne** is now manager of industrial equipment sales; **Robert Beecken** manager of railway product sales; and **Franklin M. Simpson** manager of automotive equipment sales. The three men were formerly sales representatives in the division.



Officers of St. Louis AFS Chapter bid farewell to **Fred Riggan**, foundry consultant, (second from left), who has accepted a commission with **S. G. Yulke Co.**, Stavanger, Norway, for six months.

The council of the Institute of Metals has announced its awards for 1954 at London, Eng. **Dr. Leslie Aitchison** received the Institute of Metals medal; the Rosenhain Medal went to **Prof. Alan H. Cottrell**. Both men were recognized for their outstanding contributions in the field of metallurgy.

Jack Goudzwaard is now chief metallurgist at Brillion Iron Works, Inc., Brillion, Wis. He was formerly melting supervisor for Campbell, Wyant and Cannon, Muskegon, Mich.

Eugene W. Dazmelyk has joined the research and development department of Foote Mineral Co. as mechanical engineer.

Don R. Tuley has been promoted to buyer to purchasing agent at Hamilton Foundry



D. R. Tuley . . . Hamilton buyer

& Machine Co., Hamilton, Ohio. He has been with the organization for over 20 years in various capacities.

Teruichiro Tanabe, director of Shibaura Machine Works, Ltd., Tsurumi, Yokohama, recently completed an extended study of United States foundry operations. He investigated particularly molding sand and core practice for machine tool castings, and shell molding.

continued on page 30



The Ghost

on MacGregor's Porch

...or how Chuck Wright solved a problem
with teeth in it

"There wasn't a soul on MacGregor's porch, and yet his front door bell rang five different times within a quarter hour."

After delivering these words, Chuck Wright... the Inco Distributor foundry specialist... added, "You remember MacGregor who runs the foundry for Clybar Machine Co. That kind of guy is no chowder-head."

"Mac was sitting at home last Tuesday night, watching television. He thought kids were playin' a prank the first time he answered the bell and found nobody at the door."

"But after the fourth time...and nobody there...he decided to investigate."

"Mac was sooner stepped on the porch when the ringing started again. Conscious of costs, he rushed to the basement and disconnected his batteries. The ringing stopped, but Mac knew

he faced a problem. An electrical problem.

"He *knew* what to do with a casting problem, but this electrical problem had him stopped. For instance, when Clybar added road building machinery to their line, they used a mix of about 2.00% silicon content to run such castings as lifting gears, tilting gears, scarifier cylinders and the like. This mix showed porosity in the heavier sections of cylinders, and open grain at the base of machined teeth."

"That's when Mac first wired me. He needed stronger, more uniform, closer grained iron...readily machinable and free from porosity in the heavy sections of parts having a light and heavy section tie-up."

"For sections varying from $\frac{3}{8}$ " to 2", he ran my suggested charge of 35% steel scrap, 30% pig, 35% re-



turns and purchased scrap... adding nickel to come out with a composition analyzing 1.65% to 1.75% silicon, 3.15% to 3.25% total carbon, 1.25% nickel and 0.60% to 0.80% manganese. Phosphorus under 0.30% and sulfur under 0.12%.

"As a result, Mac reduced his losses to less than 3%. Shrinkage disappeared from junctions of heavy and light sections, and a very nice finish came from machining at regular speeds."

"Since a foundry specialist answered his casting problem, the Scotchman asked an electrician for an answer to his bell problem."

"I won't repeat what Mac said later...about mice with an appetite for wire insulation...but anybody needing help with a casting problem is invited to drop me a line."

Chuck Wright

The
International
Nickel Company, Inc.

67 Wall Street

New York 5, N. Y.

March 1954 • 29

Foundrymen in the News

continued from page 28

Armour Research Foundation, Chicago, has promoted **Robert A. Lubker** to manager, metals research department. Lubker was formerly associate manager and replaces **Dr. Max Hansen** who resigned to devote full time to revising and translating his textbook on phase diagrams.

Donald L. Gross has joined Fred W. Fuller Co., Cleveland. A recent graduate of Case

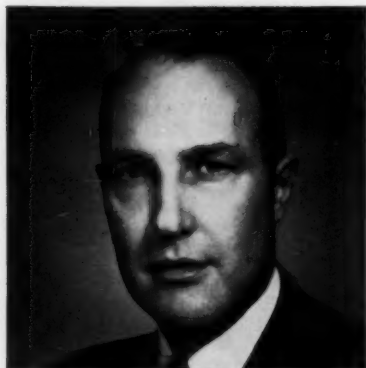


D. L. Gross . . . Fuller sales engineer

Institute, he will serve as sales engineer in the foundry field.

Louis B. Polen has been appointed manager of the River Road plant, Allegheny Ludlum Steel Corp., Syracuse, N. Y. He succeeds **R. J. Bryan**, who retires.

H. W. Kellogg is now sales engineer for Shell Process, Inc., Chicopee, Mass. He will cover Ohio, Pennsylvania and New Jersey, handling the firm's shell molding



H. W. Kellogg . . . shell mold sales

equipment. **John Nieman** will work in the same capacity in Illinois, Indiana, Michigan, and Wisconsin.

K. Jaklovic, technical manager, Vulkan, Rijeka, Yugoslavia, spent a week in



R. A. Lubker . . . research manager

Chicago, Milwaukee, and Buffalo, viewing production methods and purchasing foundry equipment. Vulkan, manufacturers of cranes, hoists, and winches for ships and shipyards, operate a gray iron and steel foundry.

Charles T. Sheehan, executive secretary, National Foundry Association, has been appointed to the Committee on Education of the President's Conference on Occupational Safety.

Fred F. Roehll, national sales manager, Eutectic Welding Alloys Corp., Flushing, N. Y., has been appointed vice-president in charge of sales for the company. He will direct Eutectic's sales throughout the U. S. and Canada.

Admiral Alan G. Kirk (Ret.), former U. S. Ambassador to Russia, has been named



John Nieman . . . with Shell Process

chairman of the board and chief executive officer of Mercast, Inc.

Al G. Jason has been named Milwaukee district manager for the Sipi Metals Corp., Chicago.

Prof. Robert S. Green, chairman of the department of welding engineering at Ohio State University, has been named executive director of the university's engineering experiment station, where he succeeds **Prof. Jacob R. Shank**.

With the principal responsibility of administering the new engine division, **Henry H. Howard** has been elected a vice-president of Caterpillar Tractor Co.

Westinghouse Electric Corp. is building a new metals development plant at Blairsville, Pa., which will be managed by **W. M. Trigg**. **Leonard W. Golden** will assist him in metals casting operations.

Two new phenolic products sales representatives have been named for the Chicago office of General Electric's chemical materials department. **Roy W. Hill** has been promoted from supervisor, customer service. **John B. Hinds, Jr.**, was superintendent and manager, St. Lawrence Foundry & Machine Co. before joining General Electric in 1953.

C. H. Kain, joint managing director, Lake & Elliot Ltd., Braintree, has been elected chairman of council of the British Steel Castings Research Association.

J. M. Weldon has been transferred to the general sales department of International Nickel Co., Inc., where he will be assistant to the vice-president. Associated with the company since 1927, Mr. Weldon will deal principally with mill and foundry products.

After 17 years of experience in the west Michigan foundry industry, **Jack D. Eurich** has joined Carl E. Rowe & Co., Inc., Milwaukee, consulting firm.

New assistant superintendent of operations at Midland, Pa. plant of Mackintosh-Hemphill Co., Pittsburgh, Pa., is **John C. Ketterer**, who was stepped up from manager of production. He has been with the firm since 1940.

Ramite Co., manufacturers of plastic, castable, and gunning refractories, has appointed **George Shutak** to the sales engineering staff of the Cleveland-Youngstown office.

Battelle Institute Columbus, Ohio, has a new member on its board of trustees: **Dr. Roger Adams**. He has had a distinguished career in the sciences since leaving Harvard University.

John O'Meara, member of the St. Louis Chapter, AFS, is now works manager, Banner Iron Works, St. Louis.

George E. Dalbey, U. S. Navy Yard, Mare Island, Cal., has retired. He was formerly associated with American Smelting & Refining Co., Eastern Brass & Ingot Co., S. L. Abbott Chemical Co., and the University of California. He is a past director of the Northern California Chapter of AFS.

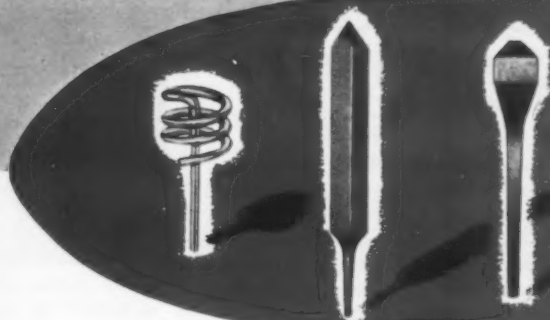
fine **FANNER** CHAPLETS and CHILLS

combine

QUALITY OF PRODUCT



All fine FANNER chaplets and chills are precision engineered and manufactured to tolerances of $\pm .002$. Their many exclusive features of design, their accuracy of construction, their special metal formulas help tremendously in the production of better castings... at lower costs... with fewer



losses — and they cost no more! In the great range of fine FANNER chaplets and chills will be the exact product to fit your needs.

Write for our Chaplet and Chill Catalogs — they are the authority in the industry.

and

QUALITY OF SERVICE

To assure customers quick, dependable, efficient service a network of fine FANNER representatives has been built up across the United States. Following are listed the many organizations serving the

foundry field, now handling fine FANNER products. Call on them for any of your regular or emergency needs — they are as close to you as your telephone and can help you.

These fine FANNER REPRESENTATIVES are eager to be of service!

ALABAMA

Hill & Griffith Co.
2931 7th Avenue, North
Birmingham 1, Alabama

CALIFORNIA

Barker Foundry Supply Co.
2428 East 52nd Street
Los Angeles, California
Grant & Co.
2144 East 7th
Los Angeles, California
Independent Fdry. Supply Co.
6463 E. Canning Street
Los Angeles 22, California
Pacific Graphite Co., Inc.
2522 Malt Avenue
Los Angeles, California
Snyder Foundry Supply Co.
2444 E. 57th Street
Los Angeles 58, California
Pacific Graphite Co., Inc.
40th and Linden Streets
Oakland, California
Snow & Galgani
533 Second Street
San Francisco, California
Federal Foundry Supply Co.
Box 25, Vernon Station
Los Angeles 58, California

COLORADO

M. A. Bell Co.
3400 Brighton Blvd.
Denver, Colorado
Federal Foundry Supply Co.
1823 18th Street
Denver, Colorado

ILLINOIS

Hill & Griffith Co.
4606 W. 16th Street
Chicago 50, Illinois
Federal Foundry Supply Co.
3536 S. Morgan Street
Chicago 9, Illinois
The S. Obermayer Co.
2544 West 18th Street
Chicago 8, Illinois

INDIANA

The John M. Glass Co.
18 S. New Jersey
Indianapolis, Indiana
Frederic B. Stevens, Inc.
36 Shelby
Indianapolis, Indiana

MASSACHUSETTS

Springfield Facing Co.
Williamansett, Mass.

MICHIGAN

A. T. Wagner Co.
2720 Wight
Detroit, Michigan
Frederick B. Stevens, Inc.
1800 Eighteenth
Detroit 16, Michigan
Wolverine Fdry. Supply Co.
3211 Ballview Avenue
Detroit, Michigan
E. J. Woodison Co.
2415 S. Aubin
Detroit, Michigan

MINNESOTA

E. R. Frost Co., Inc.
1170 15th Avenue, S. E.
Minneapolis 14, Minnesota
Federal Foundry Supply Co.
1150 S. Old Shakopee Road
Minneapolis 20, Minnesota

MISSOURI

M. A. Bell Co.
217 Lombard Street
St. Louis 2, Missouri
St. Louis Coke & Fdry. Supply Co.
1525 Sublette Avenue
St. Louis 10, Missouri

NEW YORK

The E. J. Woodison Co.
146 Chandler
Buffalo, New York
Whitehead Bros. Co.
324 W. 23rd Street
New York 11, New York
Frederick B. Stevens, Inc.
93 Stone Street
Buffalo 12, New York
M. L. Doelman
64 Russell Avenue
Buffalo, New York

NEW JERSEY

Springfield Facing Co.
Harrison, New Jersey

OHIO

Buckeye Products Co.
7920 Vine Street
Cincinnati, Ohio
Goehring Fdry. Supply Co.
919 West Fifth
Cincinnati 3, Ohio

OHIO—Cont'd

Hill & Griffith Co.
1262 State Avenue
Cincinnati, Ohio
Federal Foundry Supply Co.
4600 East 71st Street
Cleveland 5, Ohio
Gallon Fdry. Specialties Co.
131 W. Walnut Street
Gallon, Ohio
Fenton Foundry Supply Co.
134 Gilbert Avenue
Dayton, Ohio
The S. Obermayer Co.
647 Evans Street
Cincinnati 4, Ohio
Hoffman Fdry. Supply Co.
1193 Main Avenue
Cleveland, Ohio

OREGON

LeGrand Indust. Supply Co.
15 S. W. Arthur
Portland, Oregon

PENNSYLVANIA

George F. Pettinos, Inc.
1206 Locust Street
Philadelphia 7, Pennsylvania
J. S. McCormick Co.
25th Street & A. V. R. R.
Pittsburgh 22, Pennsylvania
The S. Obermayer Co.
33rd & A. V. R. R.
Pittsburgh 1, Pennsylvania
William E. Hoffman and Son
102 West 36th Street
Reading, Pennsylvania

RHODE ISLAND

Whitehead Bros. Co.
17 Exchange Place
Providence, Rhode Island

TENNESSEE

Foundries Supply Co.
120 E. 7th Street
Chattanooga 2, Tennessee
Fred H. McGee
120 1/2 E. 7th Street
Chattanooga 2, Tennessee

TEXAS

M. A. Bell Co.
3201 Sherman
Houston, Texas
Hill & Griffith Co.
1302 Nance Street
Houston 10, Texas

UTAH

Utah Foundry Supply
529 West 6th South
Salt Lake City, Utah

VIRGINIA

Federal Foundry Supply Co.
1717 Summit Avenue
Richmond 21, Virginia

WISCONSIN

Fire Brick Engineers Co.
2400 South 43rd Street
Milwaukee 1, Wisconsin

THE FANNER MANUFACTURING COMPANY
designers and manufacturers of FINE FANNER CHAPLETS AND CHILLS
BROOKSIDE PARK
CLEVELAND 9, OHIO

OHIO FERRO-ALLOY BRIQUETS WILL SAVE MONEY FOR YOU!

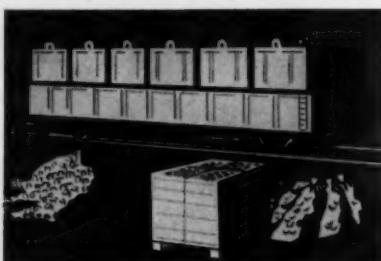
Foundries Can Slice Costs 7½ to 12% With Briquets

By utilizing Ohio Ferro-Alloy briquets you can use more scrap and less pig iron in your cupola. Cost of the charge is materially reduced, especially today when the relative cost of scrap to pig iron is so favorable.

Consider the tables below comparing a typical 1000 pound charge high in pig iron content with that utilizing silicon briquets and increased cast scrap.

Based on current delivered prices, the Ohio Ferro-Alloys briquet mixture represents a saving of 7.5% in Pittsburgh, 10.4% at Chicago, and 12.1% at Philadelphia.

In addition, Ohio Ferro-Alloy briquets can help you make better



Ohio Ferro-Alloy briquets are shipped to suit your handling facilities—bulk, bag, box type pallet, gondola or box car.

casting—reduce losses from off-iron. Easy to add to the charge at the cupola, briquets permit close and consistent metallurgical control. Such flexible control results in iron of enhanced physical properties—higher strength, more uniform structure, and better machinability.

Regular use of Ohio Ferro-Alloy briquets permits substantial

Cut Your Pig Iron Needs And Use More Scrap

reduction in raw material inventories. They may be purchased in any quantity from a bag to a carload and are available for prompt shipment packed in bags, in bulk, or in box type pallets at no extra charge.

COLOR CODED FOR EASY IDENTIFICATION

Color coded for easy identification, briquets of silicon, manganese, silico-manganese and chromium afford you a very effective method of trimming production costs and increasing the efficiency of your operation.

It will pay you to investigate the use of Ohio Ferro-Alloy briquets—for better iron at lower cost. Write us today for details.

PIG IRON MIXTURE

MATERIAL	Weight Pounds	% of Charge	SILICON		COST*		
			Per cent	Weight Pounds	Pittsburgh	Chicago	Philadelphia
Pig Iron	400	40.0	2.00	8.00	\$10.08	\$10.08	\$10.44
Returned Scrap	300	30.0	2.20	6.60	5.08	4.55	4.68
Purchased* Scrap	240	24.0	1.60	3.84	4.07	3.64	3.75
Silvery Iron	60	6.0	10.25	6.15	2.01	2.08	2.48
Totals	1000	100.0		24.59	\$21.24	\$20.35	\$21.35
Less Melting Loss, 10%				2.46			
Balance				22.13			

Theoretical Analysis of Iron 2.21% Silicon.

*Based on delivered price per gross ton at destination as of Nov. 15, 1953.
Returned and purchased scrap priced at cost No. 1 cupola grade.

BRIQUET MIXTURE

MATERIAL	Weight Pounds	% of Charge	SILICON		COST*		
			Per cent	Weight Pounds	Pittsburgh	Chicago	Philadelphia
Pig Iron	200	20.0	2.00	4.00	\$ 5.04	\$ 5.04	\$ 5.22
Returned Scrap	300	30.0	2.20	6.60	5.08	4.55	4.68
Purchased* Scrap	500	50.0	1.60	8.00	8.48	7.59	7.82
Six Silicon Briquets weighing 15 lbs. containing one lb. Silicon each				6.00	1.04	1.04	1.04
Totals	1000	100.0		24.60	\$19.64	\$18.22	\$18.76
Less Melting Loss, 10%				2.46			
Balance				22.14			

Theoretical Analysis of Iron 2.21% Silicon.



Eliminate tedious and uncertain weighing — with briquets there's no more guesswork. Simply count out the number you need and toss them into the cupola. Notched briquets available for easy halving.

Ohio Ferro-Alloys Corporation
Canton, Ohio

Chicago Detroit Pittsburgh Tacoma Seattle
Minneapolis Birmingham San Francisco Los Angeles

Talk of the Industry

CERAMIC-LINED CRUCIBLES are rumored to be giving a magnesium-alloy foundry lower melting costs and less turbulence in the melt.

DOUBLE MELTING PROCESS devised at Armour Research Foundation, Chicago, is producing titanium-alloy ingots weighing up to 100 lb. Easily applicable to commercial production, according to Foundation spokesmen, process starts with titanium and alloying metals fed into non-consumable-electrode arc melting furnace. Resulting ingot has desired metal combination but is not homogeneous enough for use, since alloying elements are likely to be segregated in parts of ingot. The ingot is next forged into a rod, then remelted as consumable electrode, dispersing alloying metals throughout mixture. Homogeneous alloy is produced.

ALTHOUGH INDUSTRY is reserving space for 1954 AFS Foundry Show at record pace, many desirable booths are still available. Combination of Exhibit and technical Convention guarantees foundrymen a comprehensive coverage of all phases of the industry. (See page 40)

CORRODIBILITY CELL at National Bureau of Standards is reported to give as good indication of corrosion resistance of buried steel or cast iron pipe or tanks as 10-year field test would yield.

SAVING OF NICKEL IN ALLOY CASTINGS is promised from research results at Battelle Memorial Institute. A. M. Hall, chief of alloy development division, announcing project sponsored by Alloy Casting Institute, says HF grade alloy, containing approximately 20 per cent chromium, 9 per cent nickel, can effectively substitute for alloy with 26 per cent chromium, 12 per cent nickel (HH grade) in intermediate temperature range of about 1200-1600 F. Research shows mechanical properties of this alloy are comparable to higher-nickel heat-resistant alloys. On pound-for-pound basis, saving of about 25 per cent in amount of nickel contained per casting should result.

INDUSTRIAL AND PROCESS PLANT CONSTRUCTION during 1954 is expected to continue at essentially the same pace as the record level of 1953, officers of National Constructors Association predicted at the organization's annual meeting. While some types of construction have tapered off from last year's high, other types—such as petro-chemical and power plants—will bolster the overall level of heavy industrial construction. Association leaders look for efforts by both construction companies and their clients to seek stabilized construction costs. Trend is toward simple, unadorned plants, consistent with long life and efficient operating and maintenance conditions.

SAND DEFORMATION is measured as final control test for sand mixes by one steel foundry after other tests establish proper grain distribution, type and amount of bond, and moisture. Mulling time and moisture are used to make final adjustment on basis of deformation readings. Same shop finds properties vary markedly with condition of mixer. Merely transposing worn wheels on a heavy-wheel muller so that side of wheel formerly facing center faced out significantly altered sand properties.



Sand is brought to conditioning equipment by industrial truck with scoop attachment (left). A separate metal



building is used for sand storage. (Right) Although many castings are stack molded, match plates are utilized.

Foundry Flexibility Permits Versatile Plant Operation

HAROLD J. WHEELLOCK / *Managing Editor*



Three indirect arc electric furnaces are used, each with capacity of 700 lb metal per hour.

COMPOUNDING its metals synthetically, Vassar Electroloy Products Inc. achieves predictable uniformity and accuracy of control in its castings, allowing minimized machining and close adherence to customer specifications.

Located at Vassar, Michigan, in the industrially rich Saginaw Valley, Vassar Products is operated by Kenneth E. Priestley, who employs 30 men in a medium-size plant that produces about 35,000 castings, totalling 5 to 8 tons, per day. As many as six different irons and steels are poured in a one-shift working day, necessitating versatility and flexibility in equipment and personnel.

The labor supply in the Saginaw area is generally good, although few experienced foundry workers are available. Training in foundry skills and techniques is necessary in most cases.

Most castings are made in stack molds or in snap flasks with match plates, although larger castings are hand rammed in tight flasks. Individual castings vary in size from 1 oz to 75 lb, are primarily specialty-type products in carbon and chrome-stainless steels, gray and alloy irons, and some non-ferrous metals.

Vassar casts corrosion, heat, and abrasion-resistant



Pouring stack mold of valve-seat insert castings.



(Above) Workman supports stack of alloy steel valve inserts on stack mold. (Below) Unloading shot blast.



valve seat inserts, and rotors for automatic transmission pumps for the automotive industry. Other products include alloy gray iron high-pressure pumps, corrosion-resistant pump bodies for the food industry, and iron and steel castings for air and hydraulic cylinders. Production runs are not large but good reproduceability is mandatory because of the type of castings made at Vassar.

The plant is semi-mechanized. Skip hoists are used to load sand mixer hoppers, and an overhead monorail system carries a bull ladle from the furnaces to the pouring floors.

Heats are mixed from plain carbon steel, crude Mexican graphite, ferro-silicon, plant returns, and ferro-alloys. Close liaison between management and the foundry workers permits a maximum of individual initiative in routine operations with minimum guidance, from charging the furnaces to packing the castings for shipping.

Uses Three Electric Furnaces

Three indirect arc electric furnaces each handle 700 lb metal per hour, giving the plant a capacity of 7-9 tons in an 8-hour working shift. One small electric furnace of 100 lb capacity is used for limited batches and experimental work. The electrics provide good flexibility and workable control over relatively small production runs.

Vassar works in green sand, using natural Tennessee sands for gray irons, and Ottawa silicas for steel and high temperature alloys. Western bentonite is added as a binder for steel casting.

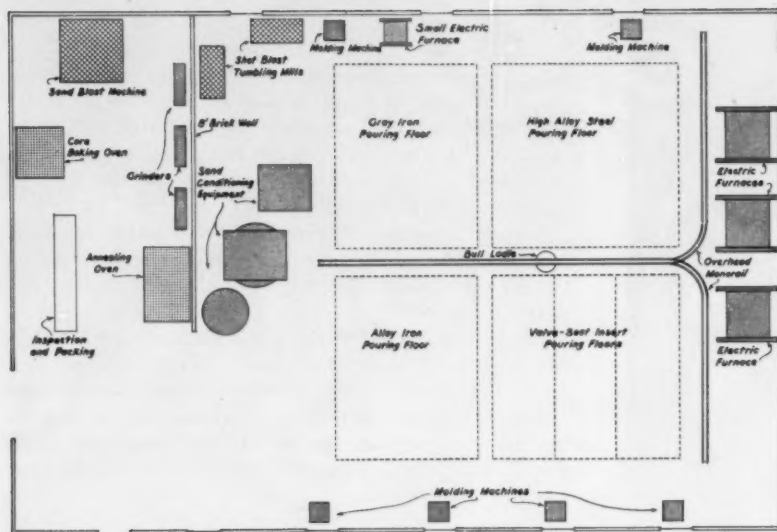
The sand is brought in by rail and unloaded into trucks at the siding by conveyor belts. All other raw materials are trucked into the plant. The sand is stored in a metal building located behind the foundry proper. From there it is transported as needed in scoop-type industrial trucks, which dump the sand into a hopper through a screen and onto a magnetic belt. An elevator carries the sand up into a hopper over the muller. Sand mixing is done at night, although some facing sand is prepared during the day.

After the sand is mulled, it is screened again and then piled. The electric trucks carry the sand to the six jolt-squeeze molding machines as it is required.

Castings made at Vassar require very little core work, although a few cores are made for some of the steel and larger gray iron casting. A core baking oven is available when required. Core sand is not reclaimed because of the relatively small scope of the coring operations.

Patterns are usually supplied by the customer, although a small amount of pattern work is done for the gating and risering of steel castings. A bench, band-saw and other equipment are available in a rigging shop.

Six casting floors are in operation, often handling as many different metals during a working day. Gray iron is poured from the furnaces into a bull ladle that operates on an overhead monorail arranged in a Y-shaped pattern for easy accessibility (see floor plan). The metal is transferred from the bull ladle and hand-shanked to the floors where the molds are poured off. High temperature alloys and steels are poured on the



Vassar Electroloy plant is approximately 120 ft x 60 ft. Departments are well sectionalized, with overhead monorail system carrying melt from three furnaces to pouring floors, where hand transfer ladles are used.

floors nearest the furnace. Gray iron and alloys are handled on the more distant floors.

Vassar casts a large quantity of valve seat inserts, which are stack molded for more efficient utilization of floor space and higher production rate. Stack molding is particularly helpful for such relatively small casting units.

An electric furnace is used to anneal steel and to heat treat steel and alloys. Two shot blast tumbling mills and a sand blast unit are employed to clean the castings. Shake-out is done on the floors at night by the crew that subsequently prepares sand for the next day's operations. Gates and sprues are removed by a battery of snag grinders. All cleaning, annealing, grinding, inspecting and packing operations are separated from the foundry by an 8-ft brick wall.

A crew of girls inspects and packs the castings for shipping. Quality in production shows its effects most obviously at the inspection table. A low reject rate is the best barometer at Vassar for measuring the effectiveness of its control program.

Individual worker training has enabled Vassar Products to develop quality control down to the operator

stage, with proper guidance. The chill test has been simplified and made nearly foolproof. Sand is tested for permeability, green compression, deformation, flowability and moisture content. A set of screens is used for determination of grain distribution.

Ventilation Good

Working conditions are maintained near the optimum by large ventilating fans which change the air 12 times each hour. Hoods over each of the furnaces evacuate the air through a stack to the outside atmosphere. Air pollution is not a major problem at Vassar, largely because of close policing of plant operations.

Dry dust collectors accumulate air-borne discharge from the snag grinders. A large outside dust collector gathers the exhaust from sand blast and tumbling mills, and sand conditioning equipment.

The plant has an excellent safety record, with few accidents, and no disabling mishaps. With a relatively small working force, the educational problem is not difficult and workers can be more effectively alerted to the dangers inherent in some foundry operations.



Castings are snag ground to remove sprues and gates. Operation is removed from main foundry area.



Crew of girls inspects and packs castings for shipment. Here they are working with valve-seat insert castings.

Use of Dielectric Ovens Speeds Core Production

GREG MINOGUE / Staff Writer

■ Time, economy, and space in the core room, as in any other production job, are definite factors to be considered in producing a good core at a reasonable cost. To this end, Moline Malleable Iron Co., St. Charles, Ill., has installed dielectric ovens and uses its brick ovens for the short run core baking jobs. With the new ovens and the addition of a conveyor belt, production has increased 15 per cent and better cores are being produced, according to P. C. DeBruyne, vice-president of Moline Malleable.

Three Tons Per Day

The firm, which employs about 275 people, produces about 30 tons of malleable iron casting a day. Chain castings form the major part of the output, averaging about 40 per cent of production. The balance is made for electrical, farm, and military equipment.

At Moline, two dielectric ovens are in operation, one with a double section. The additional section allows for extra drying or tonnage and also acts as protection against production delays.



Some cores are hand-made at Moline Malleable Iron Co. leaving core blower machines available for larger runs.

The three brick ovens originally were oil fired. To eliminate part of the danger of flashbacks during light-up, the ovens were converted to gas. The change reduced the fumes created and also cut down the possibility of flashback.

Loss From Overbaking

Prior to the installation of the dielectric ovens about a 30 per cent loss of some cores was possible. This was due to the lack of temperature control, and handling of the cores both before and after baking. A great percentage of this loss was due to overbaking when small and large cores were baked at the same time. In an attempt to bake the large cores properly, the smaller cores in the oven were sometimes burnt. In later years, controls were put on the old ovens and this helped to eliminate some of the burning, but not all. With the new production setup, there is about 2 per cent loss.

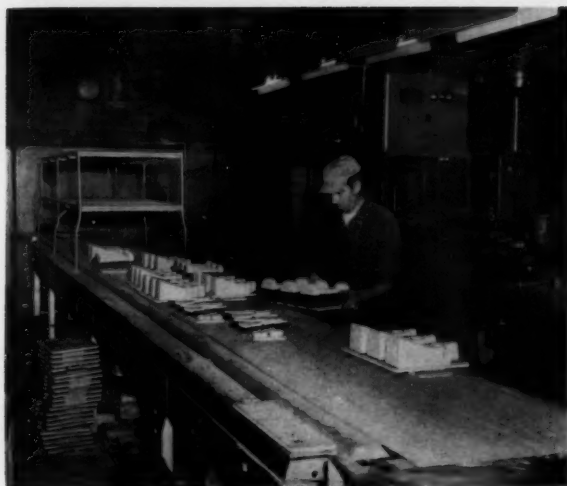
Baking time in the brick ovens averages 1½–2 hours. After this the cores have to stand for about 20–25 minutes to cool off. In the dielectric equipment, it



Core blower machines are used at Moline in conjunction with dielectric ovens for better production, efficiency.



Worker removes cores from conveyor bringing them from production area, places them on metal conveyor belt at infeed end of dielectric oven. Automatic device sprays water on cores as they enter oven, aiding in formation of hard outer shell.



Conveyor takes cores to entrance of dielectric ovens.

takes about 10 minutes for the average core from the time it is placed in the oven until it is ready for use.

The largest core which can be baked in the old ovens in two hours is about 20 lb. Cores from 1/6 oz to 75 lb can be baked in the new ovens and they can be baked at the same time. The high frequency energy causes only the water in the core to heat. Since the materials remaining after the water is removed do not absorb energy, they are not heated further and no burning can occur.

Increased Production Facilities

By using the old ovens for the short-run jobs, the dielectric ovens are available for the high production runs and part of the space formerly required for cooling is now free for production.

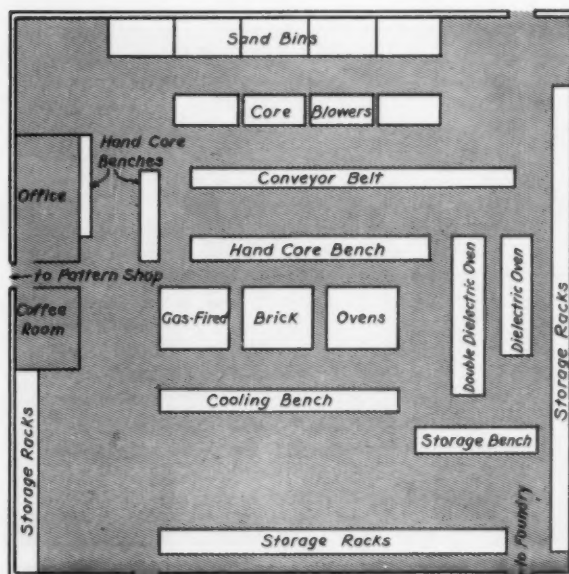
Originally Moline Malleable used plastic driers in the new ovens, but now sand driers made in the plant

are used exclusively because they "breathe" easier and are more economical. They are made by the shell mold process and baked in an electric oven.

The driers last indefinitely and with the fast baking of the cores in the new ovens, they are available for reuse more rapidly, thus eliminating the necessity of having a large supply of driers on hand.

Less Scrap From Cracks

Because of the highly collapsible binder used in the cores baked in the new ovens, there is less scrap due to cracks. The slumping or sagging encountered in the longer baking cycles of the old ovens is eliminated in the new ovens because the cores are baked in a



Floor plan of Moline core production room.



Cores are taken from electric oven immediately after baking. Former cooling-off time is now eliminated.

matter of minutes. This has meant a saving in rejected cores.

The upper electrode in the new ovens can be raised or lowered by a push-button-controlled motor. An indicator shows the electrode height above the conveyor belt, which is adjustable to accommodate cores up to 12 in. Engineers at Moline have worked out a device on the ovens which will automatically stop the conveyor belt if there is too much moisture in the green cores. Cores in the oven will continue to bake and the belt will automatically start as soon as the excessive moisture is eliminated. The belt speed is variable from 3 to 10 fpm.

Concentrated Heat

The heating section of the new ovens includes an exhaust blower of 1,500 cfm capacity to remove fumes and moisture. Heat generated by the high frequency oven is concentrated within the cores and does not affect the surrounding atmosphere, thus making working conditions more pleasant. Maintenance is practically negligible. New filters in the exhaust system are installed each week and the ovens are cleaned of dust each Saturday.

With the stepped up production in the core room at Moline Malleable it is now possible to produce a sample casting in about one hour.

Committee Invites Cost Questions

QUESTIONS on specific foundry cost problems will be answered at a Cost Session of the 58th Annual Meeting of AFS in Cleveland, May 8-14. Foundrymen seeking practical answers by experts on the Cost Committee are invited to send their questions promptly to: Ralph L. Lee, Chairman, AFS Foundry Cost Committee, c/o Grede Foundries, Inc., Box 443, Milwaukee. The 1954 question-and-answer session on foundry costs is expected to be one of the most interesting and informative staged by the Committee in view of rising interest in cost accounting, stimulated by current business conditions and some of the newer production methods.

Round Table Questions — Brass and Bronze Division

THE Round Table Luncheon of the Brass and Bronze Division, to be held at noon, Tuesday, May 11, 1954, at the AFS Convention in Cleveland, will again feature a question period. In order to facilitate the discussions, the questions are listed here in advance:

1. Why don't test bars cut from castings have the same properties as those obtained from separately cast test bars?
2. What is the effect of chemical variation within a casting on the mechanical properties?
 - a. What is the cause of this variation?
 - b. Are all copper-base alloys similarly affected?
 - (1) Red brasses (low shrink)
 - (2) Al-Mn bronzes (high shrink)
3. What effect does cooling rate have on segregation and mechanical and physical properties?
4. If metal is gassed due to a heavy slag cover while melting and this cover is removed on subsequent heats and high quality metal is then obtained, will excessive shrinkage result in this latter metal?
 - a. How do you determine the quality of the metal?
5. What problems are encountered in melting and casting the high tensile bronzes?
 - a. Aluminum bronzes
 - b. Manganese bronzes
 - c. Silicon bronzes
6. What merits are to be obtained when superheating copper-base alloys?
7. What fundamental facts about combustion should the foundryman know to achieve high quality metal?
8. Does the melting crucible enter into the gas reaction in the metal?
9. What are the economics involved in the casting of copper-base alloys in the following:
 - a. "D" Process
 - b. "C" Process
 - c. High pressure molding
10. What beneficial or detrimental effects do the minor elements have on the copper-base casting alloys?
 - a. Sulphur
 - b. Aluminum
 - c. Hydrogen
 - d. Carbon
 - e. Sodium
 - f. Potassium
 - g. Silicon
11. Why aren't synthetic sands used more extensively than natural bonded sand in the molding for brass and bronze alloys?

Annual Convention and Show Set for Cleveland, May 8-14

WITH over 290 exhibitors having reserved space in the Cleveland Public Auditorium as of February 5, the 1954 AFS Foundry Show promises to be the largest exhibit staged by the Society since the 50th Anniversary Show held in Cleveland in 1946.

So heavy has industry response been that it has become necessary to provide additional floor space. Sixty-two more exhibit booths have been allocated for the Show in a portion of the Arena, located just above the Auditorium exhibit hall. This move will make it possible for many more organizations to exhibit during the Show and Convention, May 8-14, which is already certain to surpass the 1952 Atlantic City totals. However, desirable exhibit space is still available and organizations desiring to be represented are urged to contact Exhibits Manager Al Hilbron at AFS National Headquarters.

Attendance, too, may approach the record 18,000 registrants for an AFS Convention and Exhibit. Applications for hotel rooms are now being processed by the official Housing Bureau in Cleveland. All applications received as of February 1 have now been assigned and those who have not yet made application should do so promptly. The Cleveland hotels have guaranteed the Society sufficient rooms for this Convention, although they will obviously not all be located in the two or three most requested hotels. It is also obvious that several of the downtown hotels are now completely assigned, although many desirable rooms are still available. Complete instructions are printed in the housing application forms, which were mailed about the middle of January. Prompt action is necessary by persons planning to attend. There are several excellent hotels in Cleveland but not all are in the downtown area. It is very important that companies and individuals planning to attend or be represented at Cleveland take immediate action.

As in the past several years, Company and Sustaining Members of AFS are being given the opportunity of registering, in advance of the Convention, all plant employees at the member registration fee of \$2 each, instead of the non-member fee of \$5. This rule will apply whether or not the individual employee of the company holds a personal membership in the Society. The only restriction is that registration must be *in advance*.

The Annual Banquet of the Society will be held Wednesday evening, May 12, and will be served in the Cleveland Public Auditorium. As in 1952 at Atlantic City, the banquet program will consist only of the presentation of awards, followed by a program of first-class entertainment. Anticipating an attendance of 1000, the banquet will be catered and attendance equal to or better than in 1952 is expected. Tickets should be secured in advance.

All exhibits of the 1954 Foundry Show will be fully open and manned on Saturday, May 8, which has been designated "Northeastern Ohio Day." No technical sessions will be held on this day. Foundry plant employees from the Cleveland area will be admitted to the Exhibit on May 8 only without registration fee, but with registration cards that will be widely distributed by the Northeastern Ohio Day Committee. The exhibits will be closed on Sunday, will reopen Monday morning, when the technical program also begins. The Convention closes at noon, Friday, May 14.

Ladies' activities, as arranged by the Ladies' Entertainment Committee of the Northeastern Ohio Chapter, will cover three days—Monday, May 10; Tuesday, May 11; and Thursday, May 13. The official AFS Tea follows the tradition of being held on Monday. The balance of the ladies' program is now being completed.



Of interest to Canadian foundrymen will be the Canadian Dinner scheduled for Tuesday, May 11. For the first time those attending may bring their wives. Social hour 6:00 pm. Dinner at 7:00 pm.

An outstanding phase of the Steel Division program at the Convention will be a symposium on hot tears, scheduled for Thursday morning, May 13. The symposium will include information developed from the current AFS research program, which is now being carried on in a number of cooperating foundries and at Armour Research Foundation. The steel program is concentrated on Thursday and Friday, May 13-14, with the Round Table Luncheon set for Noon, May 13.

1954 Apprentice Contest

Meanwhile, the AFS Chapter Apprentice Contest is arousing widespread early interest. The Twin City Chapter is sponsoring a contest for the first time. Other AFS Chapters also conducting local apprentice contests are: Birmingham, Detroit, Eastern Canada, Metropolitan, Northeastern Ohio, Michiana, Northern Illinois-Southern Wisconsin, St. Louis, Northern California, Southern California, and Wisconsin. This group represents the largest number of chapters ever to enter this worthwhile educational activity. In addition, many plants are also conducting local contests this year.

The 1954 Apprentice Contest closes March 12. National judging will take place at the Cleveland Trade School, 535 Eagle Ave., Cleveland, on April 2. Local contest prize winners should be shipped to that address for the judging, shipping charges prepaid, marked for the attention of Mr. F. C. Cech.

Competition is open in five division: metal patternmaking, wood patternmaking; and gray iron, steel, and non-ferrous molding. Apprentices are eligible if they are enrolled in a regular training course of not less than three years' duration, and are not over 24 years of age on the day they prepare their entry. For veterans, the age limit is 24, plus length of term of service in the armed forces, according to Prof. R. W. Schroeder, Chairman of the Committee.

The master pattern for the molding divisions of the Apprentice Contest was made through the courtesy of G. Ewing Tait, manager of foundries, Dominion Engineering Works Ltd., Montreal. Scientific Cast Products Co., Chicago, produced 17 duplicate aluminum patterns from the master pattern by the plaster mold process. Some cleaning or finishing work on these patterns was done at the U. of Ill., Navy Pier Branch, Chicago, through the courtesy of R. W. Schroeder. Drawings for the Contest projects were submitted by AFS Apprentice Contest Committee members. E. J. McAfee, master patternmaker, Puget Sound Naval Shipyard, Bremerton, Wash., made a pattern from the wood pattern drawing to check for accuracy and to determine whether the wood pattern project could be made by an apprentice in a reasonable length of time. The brass disks which were distributed to metal pattern contestants were ordered by G. E. Garvey, City Pattern & Foundry Co., South Bend, Ind., and paid

for through the courtesy of G. Ewing Tait. Fifteen boxes for shipping the molding patterns were made by the International Harvester Co., McCormick Works, through the courtesy of Eric Schwantes of the Training Department.

Members of the AFS Apprentice Contest Committee are as follows: R. W. Schroeder, *Chairman*, University of Illinois, Navy Pier Branch, Chicago; G. E. Garvey, *Vice-Chairman*, City Pattern & Foundry Co., South Bend, Ind.; J. E. Foster, *Secretary*, AFS, Chicago; F. W. Burgdorfer, Missouri Pattern Works, Inc., St. Louis; R. M. Lightcap, Rupp Pattern Co., Rockford, Ill.; E. J. McAfee, Puget Sound Naval Shipyard, Bremerton, Wash.; V. C. Reid, Jr., City Pattern Foundry & Machine Co., Detroit; G. E. Tait, Dominion Engineering Works Ltd., Montreal, Canada; and J. J. Thompson, Fletcher Works, Inc., Philadelphia.

The AFS Apprentice Contest Committee solicits drawings of possible projects for the 1955 AFS Apprentice Contest. If you have a pattern or casting which you feel would be a suitable project for apprentices to make in next year's contest, please forward them to J. E. Foster, Technical Assistant, American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5, Ill.

For details on the AFS Apprentice Contest which pays \$100, \$50, and \$25 in prizes in each division, plus round trip rail and Pullman fare between their homes and the Convention city, Cleveland, for the five first prize winners, also write Mr. Foster.

Sand Division Luncheon

For the first time, the Sand Division will sponsor a round table luncheon at the Convention. Meeting at noon, May 11, the luncheon is designed to acquaint the general membership with division activities. Theme will be: "What's In the Future?" Chairmen of each of the active sub-committees will report briefly on their phase of the division operations.

Supplementary List

The following organizations have reserved exhibit space for the Cleveland Foundry Show. They are in addition to the list printed in the February issue of AMERICAN FOUNDRYMAN.

Austin-Western Co.	Aurora, Ill.
Baird Associates	Cambridge, Mass.
Beryllium Corp.	Reading, Pa.
Burgess-Sterbentz Corp.	Cleveland
Electric Controller & Mfg. Co.	Cleveland
Euclid Foundry & Machine Eqpt. Co.	Cleveland
General Blower Co.	Morton Grove, Ill.
Glover Mfg. Co.	Meadville, Pa.
Industrial Silica Corp.	Youngstown, Ohio
Interstate Smelting & Refining Co.	Chicago
Lobdell United Co.	Wilmington, Del.
Mechanical Handling Systems, Inc.	Detroit
National Foundry Association	Chicago
Nock & Son Co.	Cleveland
Patternmaking Division, AFS	Chicago
Peerless Mineral Products Co.	Conneaut, Ohio
Rosborough Supply Co.	Cleveland
Safety, Hygiene & Air Pollution, AFS	Chicago
Semet-Solvay Div., Allied Chem. & Dye Corp.	New York
Smith Facing & Supply Co.	Cleveland
Steelblast Abrasives Co.	Cleveland
Swan-Finch Oil Corp.	New York
Thor Power Tool Co.	Aurora, Ill.
Vacu-Blast Co., Inc.	Belmont, Calif.



Fig. 1—Wheelbarrow, hoist, monorail lighten charging, formerly hand-operation from piles dumped on floor.



Fig. 2—Core removal is speeded with pneumatic chisels. Sand enters container through grate in 500-lb loads.

Productivity Ideas Increase British Output at Small Cost

Foundrymen familiar with the overseas Productivity Teams which visited United States foundries have not heard much of the other side of the story—how the visits paid off.

■ There have been many examples of large plants increasing output by applying methods suggested in the Productivity Team reports, but it is not so often that the smaller shop applies the appropriate suggestions fully. Probably there is a false idea that for this type of factory the cost would be too high. In point of fact, the opposite is the case.

Rice and Co., Ltd., Northampton, England, is a jobbing foundry, with an average output of 10 tons per day. Yet, this firm has found that it could apply many of the recommendations in the Gray Ironfoundry Report at very little cost, and with a considerable increase in efficiency. Employees have accepted the innovations willingly because laborious handling methods have been removed and, with better output, they receive a higher wage. Much of this is due to H. B. Farmer, director and works manager, a member of the team. He returned fully convinced of the importance of many of the ideas he had seen in the United States, particularly as far as materials handling was concerned. Realizing that full mechanization would not be suitable for his type of plant, he sat about adapting and developing methods suitable to a jobbing foundry, based on American practice.

For instance, the Report notes (p. 6): "In the adoption of mechanical aids in the American jobbing iron-

foundry, attention has been given to every possible aspect of the problem. Small details have not been neglected and innumerable ingenious gadgets are used to assist in the performance of even the simplest operations."

One of the simple ideas which impressed Mr. Farmer was the use of wheelbarrows, each carrying a furnace charge. In his own words, Mr. Farmer has "adopted this idea completely," and has improved on it by arranging for the barrows to be slung by means of wire rope and bale (Fig. 1). Previously, the charges had to be brought up on the elevator, dumped in half-



Fig. 3—Conveyor uses angle iron for rails, has movable section for loading castings from side floor. Pallets on grooved wheels carry castings to the shot blast.

Fig. 5 (left)—Gasoline-motor driven car pusher enables worker to move up to 100 tons without exertion. Fig. 6 (right)—Roll-over machine in ramming position. Completed cores are sprayed in background on way to core baking oven.



ton heaps, and manhandled from there into the furnaces. It was natural for the worker to start with the nearest and most convenient pile so that, by the end of the day's charging, he had to walk farther and farther to obtain his metal, a tiring procedure which resulted in him becoming progressively slower.

With the new arrangement, all these disadvantages are overcome, at very little expense. The barrows, each containing a half-ton charge, are brought up from ground level by hoist, thus saving overcrowding the elevator, and then conveyed to the charging platform on a monorail. The barrows, sufficient for a day's charging, are stacked at the back of the platform. When a charge is required, it is only necessary to wheel one of the barrows over, and tip the charge into the furnace. Time has been saved, and the job made considerably lighter.

De-coring Handling Method

Another ingenious handling method has been developed for de-coring castings (Fig. 2). As the castings come in, they are placed on a grating. Underneath the grating is a pit, holding a mobile tipping container with a sand capacity of 500 lb. In the de-coring operation, the operator uses a pneumatic chisel—here, again, the foundry has made the fullest possible use of pneumatic tools in accordance with American foundry practice—to clean the castings. All the sand falls through the grating into the container. When the container is full, the grating is removed, a bale attached to it by means of quick acting latches, and it is then conveyed by monorail direct to a track, and thence to the dump. Previously, it had to be shoveled by hand into a barrow, and then wheeled a considerable distance. After de-coring, the castings pass direct to the cleaning room where, again, full use is made of pneumatic tools.

The tipping container is another example of how a little ingenuity can save a great deal of work. It was designed by Mr. Farmer following his American visit, and is used for a great many purposes including sand handling, taking castings from the foundry to the cleaning room, disposal of rubbish, etc. It can be made easily and cheaply by any founder since it consists simply of a unit cast iron frame, with standard steel plates on each of the four sides. Built on a unit system,

it thus uses only standardized parts. The arrangement of the casters is such that the container can be wheeled along the floor, and turned, as required. The bale, swinging on a trunnion and held in position by the latches mentioned previously, facilitates slinging and tipping.

A further example of ingenious handling methods is the use of a unit type conveyor system and a compound trolley, to facilitate the handling of castings in two directions (Fig. 3). As shown, the casting is lowered by electric crane on to the trolley. The latter is, in effect, two trolleys in one. The bottom section runs on rails at right angles to the main conveyor rails. The top of this trolley carries two more conveyor rails, running in the direction of the main conveyor. On this is mounted a second trolley. Thus, the casting is carried by the trolley into an open section of the unit conveyor system, where the top rails mate-up exactly with the main rails, the bottom half of the trolley closing the gap and forming a continuous run. The top trolley is then rolled along the main conveyor where it is taken up by monorail hoist at right angles to it, and carried to the shot blast.

The rails are made of ordinary angle iron. This avoids use of rollers and ensures that, even when on



Fig. 4—Supplies are delivered directly to molder to save time lost in queuing up at tool crib.



Fig. 7—Operator strips core by simply moving lever.



Fig. 8—Quick-release tapered flasks aid production.

the floor, they are not obstructed by sand, since sand cannot settle on the apex of the angle but simply slides off. This type of conveyor has been used in a number of other ways in addition to the example illustrated. Where it is necessary to leave gangways, for instance, "level crossings" are provided by using two lengths of angle iron, to join up two sections of conveyor, these simply being lifted off spigots to open a gangway, when it is necessary to carry work across the conveyor itself at conveyor level.

The "stop-me-and-buy-one," as it is called in the foundry, is another very simple idea adapted from an American idea by Mr. Farmer (Fig. 4). Previously

much time was wasted by molders walking to the tool crib and queuing for materials. To obviate this, the cart seen in the illustration was built, containing three rows of trays which hold all the materials required by molders such as wire nails, studs, parting powder, chaplets, etc.—everything, in fact, except lifters. In addition it serves coal dust, plumbago, and blacking.

The trolley is brought around at 10:15 each morning, by which time each molder knows what work he is on and what he needs for it. As the cart comes to him, he helps himself from the drawers. Time-wasting at the tool crib has been eliminated.

Labor-Saving Car Pusher

Outside the foundry, a car pusher saves time and labor (Fig. 5). In operation, it is placed on the rails, and the jack is raised hydraulically until the arm is under the car. The clutch is then let in, and the car moves along the siding as required, operated by one man without effort. It can move up to 100 tons.

The roll-over machine was also developed by Mr. Farmer. The original design was worked out before he left for the U.S. However, plans are now in hand for improving this still further, including motorization. Previously, the cores were made on the floor, after which they were stripped, also by hand, and then conveyed manually to the core oven.

The device illustrated (Fig. 6 and 7) obviates all this. Angle iron rails are used as a conveyor, this time on the floor, and it will be seen that they remain completely free of sand. Pneumatic rammers, slung overhead and counterweighted, are employed as in so many other applications in this foundry. The butt-rammer head is immediately interchangeable with a

Fig. 9—Flasks are rapidly stripped from molds without lost motion or danger of shifts during operation.



peen rammer, the two providing all the ramming necessary in the preparation of the core. Previously, it was common practice to stamp the sand down by foot.

Once filled, a plate is placed on the box (quick-acting clamps facilitate this operation), a catch is released, and the entire assembly is free to roll over by gravity. It is allowed to swing until it has settled in the reverse position. In this position, it is rapped and, by employing the hand wheel on the left (Fig. 7), a jack is brought up under the pattern. The operator then uses the lever on the right to lift the box and strip the core. The core is now brought down by operation of the handwheel to conveyor level and is free to run on its trolley on the rails and, as may be seen (Fig. 6), passes to the sprayer. From there, it continues, to the oven for baking.

Thus, with very little expense, a process has been brought off the floor and, within the limits of a jobbing foundry, been mechanized. The various lifting motions will eventually be powered. From the spraying operation, the core is transferred to the oven by monorail conveyor. Other advantages of this method include the fact that there is practically no finishing to do after the core has been drawn. Patching which is common when cores are made on the floor, is not required.

It should not be thought that all the ideas brought back by Mr. Farmer dealt with materials handling. A number of other ideas has been adopted. The following two are typical:

In the Productivity Report, under the section on molding practice, it is reported: "The most outstanding



Fig. 10—By transferring jackets and weights as pouring proceeds, a minimum of equipment is made to serve a molding floor.

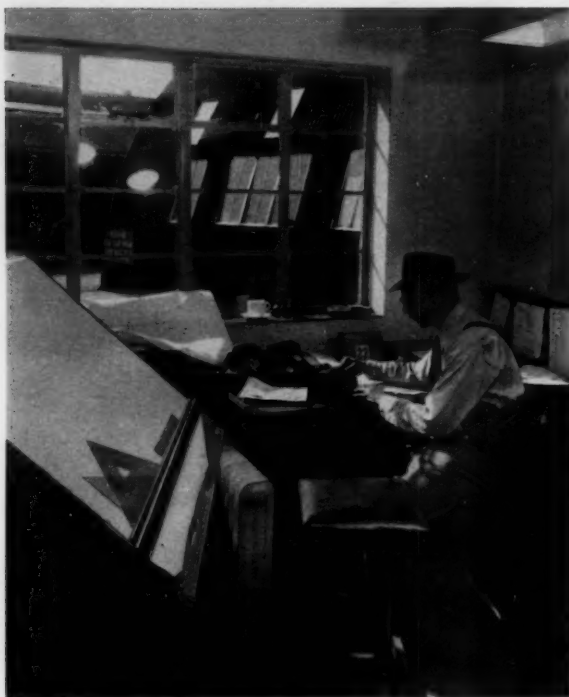


Fig. 11—H. B. Farmer, director and works manager, Rice & Co., Ltd., Northampton, England, using calculator to cut time in estimating casting weights.



Fig. 12—Pilot plant for shell molding shown, and orders on hand, provide basis for establishing production plant which will soon be in operation.

feature in the production of light castings is the almost invariable use of snap and taper flasks in both machine and hand-molding operation. The pop-off flask is probably the most highly developed flask of this type. The double pin, combined with the adjustable pin guides, facilitates accurate lifting off of the top part."

Mr. Farmer was sufficiently impressed with this equipment to obtain Board of Trade Authority to import the necessary equipment from the U.S. Figure 8 shows the pop-off flasks on an American jolt-squeeze machine.

Removal of the flask and pouring are shown in Fig. 9 and 10. In the latter, the molds are poured alternately, the operator transferring the jackets as pouring proceeds. In this way, a limited number of jackets and weights can be used for an entire run of castings.

By using this equipment, over 100 molds per day per man can be produced where, by the previously used machine molding methods 50 molds was the expected average per man. Equipment cost using the pop-off flask is much reduced as is the initial cost of the machine and operating expenses when compared with the equipment and machines used for 50 per cent less production.

American Methods Helpful

Finally, even the office has found advantages in American methods. While in America, Mr. Farmer was impressed with the office methods used and, also, the use of calculating machines to facilitate the work of the drawing office. Figure 11 shows Mr. Farmer, who does most of the major designing work himself, in his drawing office. The calculator, which he is employing, is being used for calculating volumes from drawings, in order to determine weights of castings. When not in use for this purpose, it has many other applications, including the compilation of statistics, and for costing.

This firm has also had a small pilot plant working on the shell-mold process for two years (Fig. 12), and has now obtained sufficient running orders to warrant the installation of a full productive plant which is being pushed ahead with full vigor.

Foundry Term Glossary Available

The *Glossary of Foundry Terms* was developed by the AFS Foundry Terminology Committee and is the result of much detailed research, beginning in 1948 with a tentative glossary. The compilations were submitted to representatives of the foundry industry throughout the country for criticism and comments and a revised glossary was presented to the AFS Technical Correlation Committee in June, 1950.

Additional revision and enlargement were undertaken in 1950 by a newly formed Foundry Terminology Committee. The recently completed work was cross checked against many existing glossaries, dictionaries, and current definitions of scientific and engineering terms.

This indispensable booklet can be purchased for 75¢ by members, \$1.25 by non-members, from Book Dept., American Foundrymen's Society, 616 South Michigan Ave., Chicago.

Molding Sand Mixtures

Introduction

These molding sand mixtures were compiled by the AFS Foundry Sand Handbook Revision Committee to provide foundrymen with a guide to typical sand practices. The tables are taken from **FOUNDRY SAND HANDBOOK**, sixth edition (1952), published by American Foundrymen's Society.

STEEL*FOUNDRY MOLDING SAND MIXTURES

Mixture No.	Sand Type	Materials, Per Cent by Weight				Properties		Casting Weight, lb	
		Sand	Bentonite	Cereal	Other	Water	Green Comp., psi		Perm.
GREEN SAND FACING—FINE SANDS									
1	N. J. No. 60	95.8	3.5	0.75	....	3.0-3.5	4.5	190	1000 max
2	Portage No. 65	100	3.0	1.5	....	3.2	5.5-6.5	110-140	2500 max
GREEN SAND FACING—COARSE SANDS									
3	Ottawa No. 45	96.65	3.0	0.35	....	2.2-2.7	8.0-9.0	200-220	100-1000
GREEN SAND FACING—BLENDS, NEW SAND									
4	Ottawa 50 Mesh Ottawa STD, Bond	75.5 18.8	4.8	0.9	....	2.8	8.0-9.0	120	2-25
5	Ottawa 50 Mesh Ottawa STD, Bond	76.5 19.0	3.2	1.3	....	2.2	5.5-6.0	120	1-15
6	Ottawa 50 Mesh Ottawa STD, Bond	75.3 18.8	5.0	1.2	....	3.0	7.5-8.0	120	Over 25
GREEN SAND MIXTURES—BLENDS, OLD AND NEW SANDS									
7	No. 30-200 82GFN Ga. Wash 41GFN No. 2 Sharp 31 GFN	47.2 23.6 23.6	4.7	0.43	....	3.9	8.9	126	5-2500
8	Washed Reclaim Heap Sand	8.0 91.6	0.35	0.10	....	2.6-3.0	8.0-9.0	190-230	5-400
9	Portage GFN 68 Old Sand GFN 60	65 35	2.0	0.75	....	3.0-3.4	5.5-6.0	110-140	100-2000
10	N. J. GFN 50 Used Sand	75 25	4.0	1.0	....	3.5-4.5	6.5-7.5	135-150	50-200
11	Ottawa GFN 44 Old Sand Silica Flour	28.5 66.5 2.85	1.14	1.24	....	3.5	6.5-7.5	180-220	6-400
12	N. J. No. 60 Old Sand	58.5 38.8	1.7	0.68	....	2.5-3.5	3.0-4.0	175-200	50-2000
DRY SAND FACING MIXTURES									
13	Portage GFN 40	65	3.5	1.5	Silica Flour 30	6.0-7.0	6.5-7.0	20-40	Few Tons
14	Ottawa GFN 40	80	3.5	1.5	Silica Flour 15	6.0-7.0	6.5-7.0	20-40	Few Tons
15	N. J. 60	69	Core Oil 1.4	1.4	Silica Flour 28	7.0-8.0	3.0-3.5	55-65	5-10 Tons
SKIN-DRY MIXTURES									
16	N. J. GFN 50 Old Used Sand	45 45	6	1.5	Silica Flour 10	4.0-5.0	9.0-9.5	110-130	200-2000
17	Portage GFN 68	95.5	3	1.5	....	4.0-4.4	5.5-6.5	90-120	Over 5 Tons
18	N. J. No. 60	95.5	3.7	0.8	....	3.5-4.0	5.5	170	500-3000
19	GFN 55 Ottawa Crude Heap Sand	43.8 54.6	1.35	0.25	....	2.8-3.2	7.5-9.0	200-225	50-400
20	Ottawa No. 40 Heap Sand	68.0 22.4	2.7	1.2	Silica Flour 6.5	3.8-4.2	6.5-7.5	180-220	6-4000
21	Ottawa GFN 56 Dextrin Gums—0.26	87.0	3.48 Bark Flour—0.26	Resin—0.26	Silica Flour 6.96 Grade 0 Perlite—0.26	3.0-3.5	6.5 Oilless Compound—1.04	100-140	500-5000

GRAY IRON FOUNDRY MOLDING SAND MIXTURES

Sand Mixture No.	Sand Type	Material, Per Cent by Weight						Properties		Casting Weight, lb	
		Sand	Bent.	Sea Coal	Wood Flour	Cereal	Other	Moisture	Green Comp., psi		Perm.
GREEN SAND MIXTURES											
22	8-M Dorchester Molding Sand	95.5	...	Ohio Plastic Fireclay 1.0	Pitch 3.5	...	...	5.5-6.5	7-11	30-60	1/4-20
23	H505 Portage Silica	89.3	5.35	5.35	...	...	...	2.8	8.3	110	1-30
24	Silica GFN 64 Unit Sand	3.5 95.3	0.4	0.7	C.14	...	...	2.6-3.0	11-12	85-95	50-150
25	Port Crescent (Mich.) Sand	86	4	10	...	...	Tot. Comb. 10	4.0-4.5	7.5-8.0	80	60-300
26	McConnellsville N. Y.	94	3.5	...	2.5	...	Tot. Comb. 2.5	3.5	7.0	45	1-20
27	Bank Sand Fine Sand	97.8	0.76	0.76	...	0.22	Pitch 0.55	4.8	11	80	20-150
28	Heap Sand Silica from Santa Cruz Mts.	78.0 20.0	1.0	0.6	0.4	...	...	5.5-6.0	8-10	30-50	100 max
29	No. 30-200 Silica GFN 65.2 Geo. Wash Sand	91.7	4.1	1.7	0.7	0.2	Pitch 1.6	4.4	10.2	76	150-825

(continued next page)

Foundry Facts

Molding Sand Mixtures

GRAY IRON FOUNDRY MOLDING SAND MIXTURES (cont.)

Sand Mixture No.	Sand Type	Material, Per Cent by Weight							Properties		Casting Weight, lb
		Sand	Bent.	Sea Coal	Wood Flour	Cereal	Other	Moisture	Green Comp., psi	Perm.	
SKIN-DRY MIXTURES											
30	Heap Sand Millville Gravel No. 50	84.0 14.0	...	...	...	...	Pitch 2.0	5.8	7	6	100 to 30,000
31	No. 60 Millville Sand	95.2	...	Ohio Plastic Fireclay 1.1	Fitch 3.7	...	...	5.5-6.5	6-10	50-75	1000 max
32	Lycorning No. 45 Sonittep No. 5 Heap	19.1 28.5 47.6	...	3.6	...	...	EZ Clean 1.2	5.0-5.5	7	50-60	60-4000
33	Port Crescent McConnellsville	45.5 45.5	3.9	4.6	...	0.6	...	3.5-4.0	8	70-80	60-4000
34	W & D Silica System Sand	95.4	1.6	0.7	...	0.14	Fireclay 2.1 Pitch 0.17	4.0	11	170	500-3500
DRY SAND MIXTURES											
35	No. 3-0 Dorchester Gravel	90	9.15	...	0.17	...	Pitch 0.7	6.0-8.5	6.5-9.5	75-125	200 to 10,000
36	Lapis No. 2 Silica Heap	19.5 78.2	0.7	...	0.6	...	Pitch 1.0	6.5-7.0	9-11	50-70	100 to 20,000
37	Old Washed Hayville Gravel	63.3 32.9	...	...	...	...	Pitch 3.8	7-8	8-10	70-80	300 to 120,000
38	W & D Silica GFN 68	79.5	...	...	...	Raw Linseed Oil 1.75	Silica Flour 18.9	3.5-4.0	...	48-50	1000-4000
39	W & D Silica GFN 68	65.8	...	...	...	Raw Linseed Oil 3	Silica Flour 31.2	3.5-4.0	...	33-35	1000-4000

MALLEABLE IRON FOUNDRY MOLDING SAND MIXTURES

Mixture No.	Sand Type	Materials, Per Cent by Weight						Properties		Casting Weight, lb
		Sand	Bent.	Sea Coal	Wood Flour	Clay	Water	Green Comp., psi	Perm.	
40	Unit Sand	99.45	0.036	0.015	0.0002	...	3.0-3.4	7.5-8.5	120	1 oz to 30 lb
41	N. J. 50 N. J. 110	50 50	...	2	...	5	3.5	6.0-8.0	70-80	1 oz to 10 lb

MAGNESIUM ALLOY FOUNDRY MOLDING SAND MIXTURES

Mixture No.	Sand Type	Materials, Per Cent by Weight							Properties		Casting Weight lb	
		Sand	Boric Acid	Sulfur	Diethyl Glycol	Ammonium Silico-Fluoride	Bentonite	Water	Green Comp., psi	Perm.		
42	Nevada No. 100	91	1	1	1	1	2.5 Dixie Bond	2.5	4-5	11	27	....
43	Bank Sand GFN 60	91.74	...	0.4-0.7	1	Dow Agent No. 190 4.6	3.7	2.6-3.0	9-11	90-120	2000 max	
44	Geauga Lake Blend GFN 60	89	2	1.5	2	....	3.0	2.3-2.7	6.3	140	1000 max	

ALUMINUM ALLOY FOUNDRY MOLDING SAND MIXTURES

Mixture No.	Sand Type	Materials, Per Cent by Weight					Properties		Casting Weight, lb
		Sand	Fireclay	Bentonite	Wheat Flour	Water	Green Comp., psi	Perm.	
45	New Bank Albany No. 0	99.5	...	...	0.5	5.5	5.0	18	All Weights
46	Boulder Creek	74	4.6	2.8	Silica Flour 18.5	5.0-5.5	8-10	20-30	1 oz to 20 lb

BRASS AND BRONZE FOUNDRY MOLDING SAND MIXTURES

Mixture No.	Sand Type	Materials, Per Cent by Weight							Properties		Casting Weight, lb
		Sand	Bent.	Cereal	Grade O Perlite	Sea Coal	Other	Water	Green Comp., psi	Perm.	
47	Albany No. 0	As F'elivered	...	...	...	...	...	5.5	4.8	18	1 oz to 5 lb
48	Natural W & D Silica Millville	47.6 47.6	4.0	0.8	...	...	...	4.0	6.5	65	Up to 2000
49	Backing Sand 30% McConnellsville 50% Juniata 20% Bremen	80 15	4.0	...	...	...	Wood Flour 1.0	4.4	14.5	30-35	2 oz to 10 lb
50	Backing Sand Juniata (New)	75 20	5.0	...	...	...	...	4.0	20	40	2 oz to 1 ton
51	Zanesville Albany No. 0 (6% H ₂ O)	89.3 7.2	1.0	0.1	0.7	0.5	Oilless Compound 1.2 Resin 0.1	5-6	7	18-21	20-80
52	Albany No. 0 (6% H ₂ O)	77.4	5.4	...	17.2	8.5-9.0	12-14	10-11	Up to 100

Casting Quality as Related To pH Value of Molding Sands

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Better control of molding sand properties and marked reduction in casting defects accompanied adjustment of pH in green sand mixtures. Written discussion of this paper, Convention Preprint 54-60, should be sent to American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5, Ill. This paper will be presented at a Sand Session of the AFS 58th Annual Meeting, Cleveland, May 8-14, 1954.

■ Most sand foundrymen are familiar with those periods when the sand "goes bad." Molds tear, erode, scab, and buckle. The gating is changed, something is added to the sand, and after awhile, the sand is good again. Then one day the trouble reappears. Should the gating be changed back again, should something else be added to the sand, or maybe taken out? It is the same old merry-go-round. Unitcast was no exception and rode the merry-go-round for years along with other foundrymen.

In December 1952, the sand started to feel brittle; molds tore along the edges as the patterns were drawn and were most difficult to patch. Castings had a rough surface, showed erosion and scabbing, and nothing that was done gave any improvement. Extra soft ramming reduced scabs but erosion was worse and swells were prohibitive. Figure 1 shows a mild case of drag scabs and rough finish with protrusions due to slight tears along the parting line. No laboratory tests gave any clue to the difficulty except that the fines were high (AFS clay 12.5 per cent) as a result of trying to keep the strength up by adding more clay.

Measuring pH Factor

The senior author suggested that the pH of the sand be measured. A pH meter had been purchased in 1949 following the paper by Booth.¹ Laboratory work conducted at that time had shown little change in sand properties as the pH was varied and pH had been forgotten.

This time when the pH of the western bentonite being used was measured, the operator was ready to overhaul the instrument because it was "off"; it is known that western bentonite is basic and the instrument showed it to be acid. But the instrument was correct. The pH value of the bentonite was 5.25 and

all the system sand (over 700 tons) was also acid with a pH of 5.0. No one knew what to do about it.

Foundrymen have not been totally ignorant of the possible influence of pH on the properties of sand mixtures. For example, the *FOUNDRY SAND HANDBOOK* specifies the use of sodium hydroxide in the AFS Clay Test to keep clay from agglomerating when cereal is present. Booth¹ measured room temperature properties of natural molding sands and found significant changes occurred as sodium carbonate was added. Pavlish² reported the effect of numerous chemicals on the green and dry strength of clays but again the practical tests on castings were lacking. Taylor³ stated that the pH value could be used to control sand properties but gave no reference to the properties desired or the method to be used.

In view of this lack of information, a critical review of the literature on clays was made and the decision to add soda ash, the commercial grade of sodium



Fig. 1—Drag scabs and rough finish at parting line resulting from sand brittleness.



Fig. 2—Steel test castings made in black facing sand. pH values range from 5.5-9.9 (left to right). For other properties, see Table 1.



Fig. 3—Center castings, best of the four, were made in sand of pH 10.2 and 10.4. No. 1 had pH 8.5, No. 4 was made in sand containing commercial sand conditioner.

carbonate, to the sand was reached. Trouble disappeared with the first addition; once again Unitcast was off the merry-go-round.

Wishing this ride to be the last, a program for further work was established. A series of test castings was made from black facing sand to determine if there was an optimum addition. This black sand, from the system, had a pH of 7.9 due to the soda ash additions. Two batches were lowered to 5.5 and 6.6 by the addition of acetic acid and two were raised to 9.5 and 9.9 by further additions of soda ash. Test castings of Grade 2 steel are shown in Fig. 2 and the laboratory results are given in Table 1. The test results indicated that pH values considerably higher or lower than 7.9 were detrimental to this particular sand mix. A temporary range of 7.8 to 8.3 was established for all black facing.

As it was not known how far this treatment of clay could be stretched, caution dictated that no more acid bentonite be used. A procedure was established under which all cars of bentonite are sampled ac-

cording to a pattern and the pH values analyzed for statistical significance. Since the start of this sampling, no further shipments of acid bentonite have been received.

No Standard Adopted

No standard practice for the addition of soda ash to new sand facing was adopted pending investigation. The pH of this facing paralleled that of the bentonite usually being about 0.1 pH value lower. The first series of four castings was made from 3 per cent bentonite, 0.75 per cent cereal, and 3 per cent water. A sieve analysis typical of the sand used is given in Table 2.

The first casting was from the untreated mix, pH 8.5, the second and third from mixes treated with high soda ash additions to give pH values of 10.2 and 10.4 respectively; and the fourth mix was treated with a commercial sand conditioner. Mixes two and three were free from any tendency to lump and were more resistant to erosion. No cope scabs occurred in any mix (Fig. 3).

In the second series, the cereal was reduced to 0.25 per cent and the moisture addition to 2.5 per cent. Varying amounts of citric acid or soda ash were added to vary the pH value of the sand mixture (Table 3). The results show a trend toward improved castings at higher pH values (Fig. 4). Again, no cope scabs occurred. Extra low values were then obtained by adding acetic acid (Table 3). Casting quality decreased as the sand mixtures were made more acid (Fig. 5). With the exception of the lowest pH value, no particularly bad scabbing was encountered.

Bond additions were lowered to produce scabs. With 2.5 per cent bentonite, no cereal, considerable erosion was encountered at low pH values (Table 4, Fig. 6). At high pH values (Table 4, Fig. 7) the sand packed to such high density that cutting the sprue and pop-off disturbed sand some distance away (Fig. 8). It was necessary to patch two molds and these two scabbed at the patch. However, little erosion occurred. The holes in the drag side were caused by the falling scabs.

Further Experiments

This experiment was repeated with 5.0 per cent fireclay with similar results. Here the pH level at which good castings were produced was somewhat lower (Table 5, Fig. 9). In none of these tests had the usual green strength properties showed any significant trend. Without pH measurement, interpretation of the results would have been most difficult.

Two series of gray iron castings were then made at Alloy Founders, Inc. A test casting previously used in the study of molding materials was chosen.⁴ The regular facing in use at the foundry was taken for the first test. As used in the foundry, the new sand

TABLE 1—Properties of Black System Sand

MIXTURE	pH	Spec. Wt., g	H ₂ O, %	Perm.	Green Comp.	Air Dry, 12-hr.,	Green Shear	12-hr. Shear	Hot Compressive Strength psi			
					St., psi	St., psi	St., psi	St., psi	400F	1000F	1400F	1800F
Regular Black Facing.	5.5	159	3.4	180	12.2	77	3.3	62	100	87	113	345
PROCEDURE	6.6	159	3.4	185	12.1	73	3.2	51	105	80	138	400
Add soda ash, mull 3 minutes, take	7.9	159	3.4	180	11.6	54	3.3	46	80	63	88	330
physical tests, make test molds. Jolt	9.5	159	3.4	180	11.1	44	3.2	37	85	68	95	235
drag 10 times, cope 1.	9.9	159	3.5	170	10.4	38	3.1	36	88	80	110	435

Fig. 4—Casting finish improved from left to right as pH of new facing sand increased. No cope scabs occurred in the series. See Table 3 for sand properties.

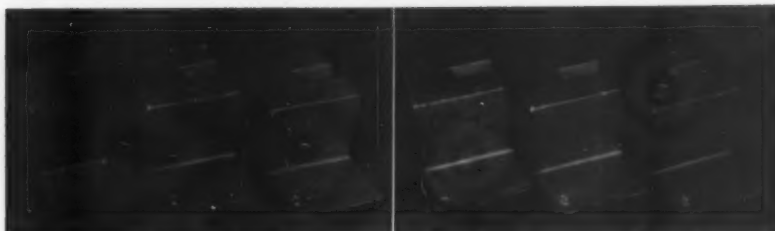


TABLE 2—Typical Screen Analysis
Ottawa Sand, Washed and Dried

Screen No.	Per Cent Retained
30	0.04
40	0.36
50	25.00
70	37.23
100	22.68
140	12.00
200	1.89
270	0.27
Pan	0.14
AFS Grain Fineness No. = 60.6	

added to heap sand for additional bond did not mix in well and numerous small clay balls were present despite mulling and aerating. Batches of 15 pounds each were mulled with various soda ash additions. Drags were jolted ten times and finished off with a hand rammer. Figure 10 shows that the facing as used in the shop gave good results. The extra mulling and the additions of soda ash raised the green strength to the point where the sand lumped and gave many supervoids. Scabs occurred up to a pH of 7.2. The castings at pH values of 8.2 and 8.5 were scab-free but the rough finish remained.

For the second series, the opposite extreme was chosen; the test castings were made from heap sand and no bond additions were made (Table 6, Fig. 11). This time the drags were jolted 25 times to insure dense packing at the pattern face. As the pH was raised, scabbing passed through a minimum. At the higher pH values the sand packed to a higher density and the bond content was insufficient to prevent scabbing.

It has been demonstrated that casting quality is greatly dependent on some property of a sand mixture that may be changed by chemical additions and controlled through the use of pH measurement. An explanation of this phenomenon necessarily brings up some concepts new to many foundrymen. Discussion of these follows this outline:

1. The Importance of Small Particles.
2. The Meaning and Use of the pH Value.
3. The Effect of Chemicals on Clay.
4. A Practical Approach to Your Molding Sand.

Importance of Small Particles. Molding sands must be considered as a mixture of small particles—sand grains, and colloidal bonding materials. Sand is a particle size classification of non-metallic minerals of approximately 0.002 to 0.13 in. (50 to 3360 microns) in diameter. The term *colloid* applies to the particle size classification of materials of approximately one

Fig. 5—Cope (upper) and drag (lower) sides of test castings made in an increasingly (left to right) acid sand. Casting at right (pH 4.6) scabbed badly. See Table 3.

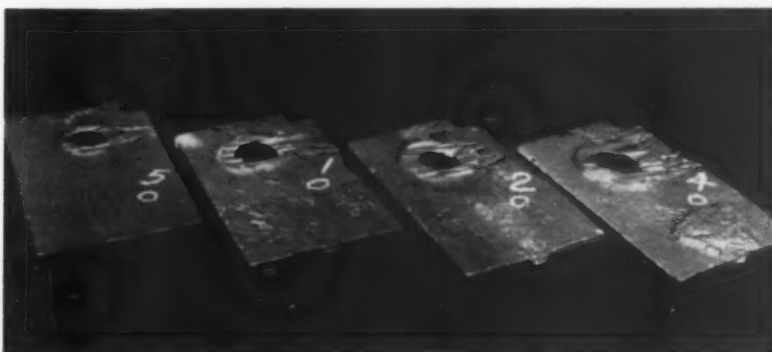


TABLE 3—Effect of pH on New Sand Facing Containing Bentonite and Cereal

	Casting No.	Addition Chemical	Amount	pH		Spec. Wt., g	H ₂ O, %	Perm.	Green Comp. St., psi
				Evening	Morning				
MIXTURE									
4800 g Sand	1	10% Citric Acid	15 ml	5.5	6.1	164		170	1.8
144 g Western Bentonite	2	None		8.4	8.0	164	2.0	180	2.2
12 g Cereal	3	Soda Ash	0.25 g	8.9	8.1	164		195	1.7
120 ml Distilled Water (reduced by volume of acid added)	4	Soda Ash	1.25 g	9.4	9.3	164	1.8	200	1.8
	5	Soda Ash	2.50 g	9.4	9.7	164		195	2.1
	6	Soda Ash	4.38 g	9.4	9.9	164	1.8	180	1.8
PROCEDURE									
Mull one minute dry, six minutes wet, measure pH value, store overnight, measure pH value, make physical tests, make test molds. Jolt drag 10 times, cope 1 and squeeze.	05	10% Acetic Acid	3 ml	7.5	7.3	162	1.7	190	2.0
	10	10% Acetic Acid	10 ml	5.7	5.5	162	1.7	190	2.0
	20	10% Acetic Acid	20 ml	4.6	5.0	162		200	1.9
	40	10% Acetic Acid	40 ml	4.4	4.6	162	1.7	190	2.0
Note: Castings 05 through 40 cast in separate heat.									

Note: Castings 05 through 40 cast in separate heat.

TABLE 4—Effect of pH on New Sand Facing—No Cereal

	1	10% Acetic Acid	30 ml	4.6	4.4	163.5	1.4	220	1.2
	2	10% Acetic Acid	20 ml	4.9	4.6	163.5		250	1.3
MIXTURE									
4800 g Sand	3	10% Acetic Acid	7.5 ml	6.1	6.0	163	1.2	220	1.1
120 g Western Bentonite	4	10% Acetic Acid	4 ml	7.1	7.2	163		245	1.0
100 ml Distilled Water (reduced by volume of acid added)	5	None		8.4	8.2	163		225	1.1
	6	Soda Ash	1 g	9.7	9.5	163		240	1.2
	7	Soda Ash	5 g	10.0	9.9	163	1.0	230	1.1
	8	Soda Ash	10 g	10.0	10.1	163		220	1.2
PROCEDURE									
Same as in Table 3.	9	Soda Ash	25 g	10.1	10.35	163	1.1	215	1.3

Note: Castings 6 through 9 cast in separate heat.

TABLE 5—Effect of pH on New Sand Facing—Fireclay

	00	Acetic acid	3 ml	4.4	3.8	167		170	1.0
	0	None		4.9	4.0	167	1.7	180	1.1
MIXTURE									
4800 g Sand	2	Soda Ash	0.48 g	5.2	5.0	167		190	1.0
240 g Fireclay	3	Soda Ash	0.96 g	6.3	6.0	167	1.7	160	1.0
144 ml Distilled Water (reduced by volume of acid added)	4	Soda Ash	1.44 g	7.6	6.7	167	0	170	1.1
	5	Soda Ash	1.92 g	8.3	7.5	167	1.7	160	1.0
	6	Soda Ash	2.40 g	8.6	7.5	167		200	0.9
	7	Soda Ash	6.00 g	9.6	9.3	167	1.7	150	1.0
PROCEDURE									
Same as in Table 3.	8	Soda Ash	18.00 g	10.1	9.8	167		180	0.9

fifty-thousandth to one twenty-five-millionth in. (0.5 to 0.001 microns) in diameter. These particles may be animal, vegetable, or mineral; small perhaps, but only relatively so. Consider these dimensions in relation to the earth.

The mountain and ocean floors of the earth represent maximum variations of about 0.25 per cent of the earth's diameter. Without them the earth's surface would be ice capped at the poles with a shallow sea

between and life as it is now known would cease. Knowing that the high and low spots on a sand grain may easily represent 25 per cent of the grain's diameter, can foundrymen ignore the possible results of such variation?

The planet Earth is considered a significant part of the universe, yet, taking diameters as a measure of size, the smallest particle large enough to be considered colloidal is about two dozen times as large,

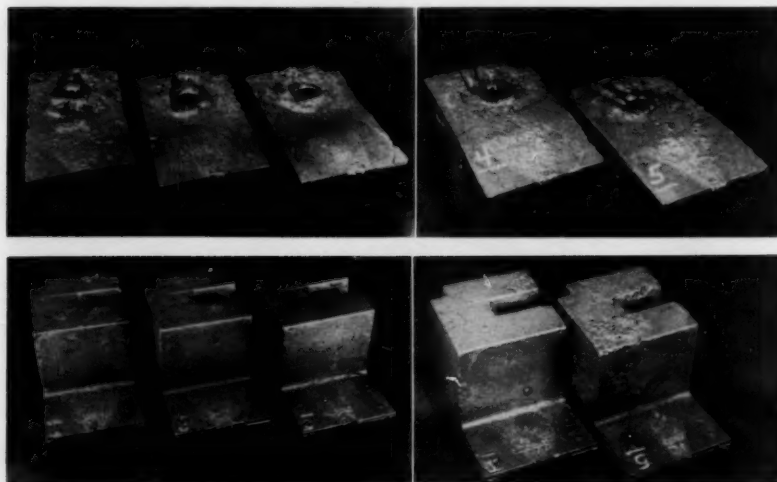
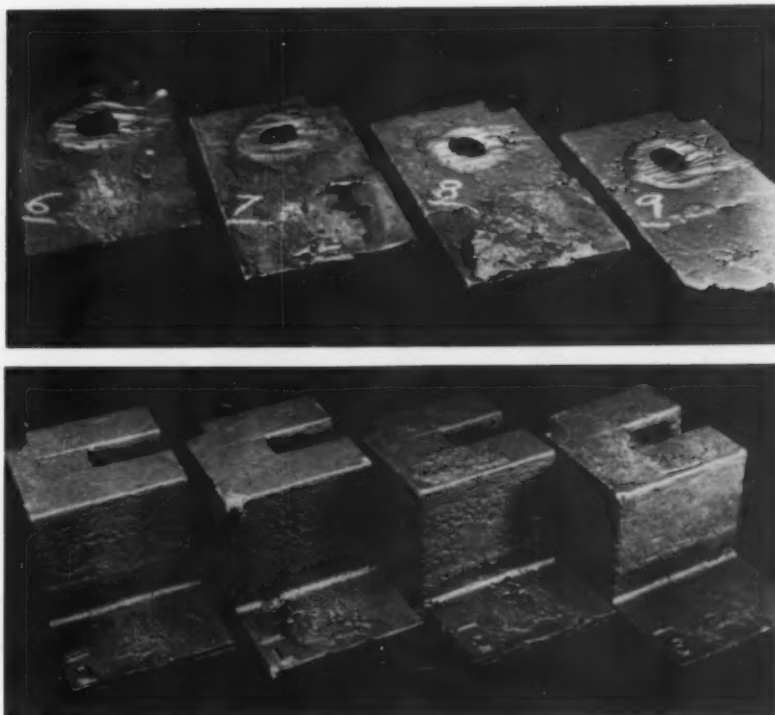


Fig. 6—Cope (upper) and drag (lower) sides of castings made in new facing without cereal. pH ranges (left to right) from 4.4-8.2. Refer to Table 4 for further data.

Fig. 7—New bentonite sand facing without cereal, pH 9.5-10.35, left to right, produced these test castings which scabbed badly. Refer to Table 4.



in relation to the earth, as is the earth in relation to the universe. Truly the smallness is only relative. Those who have an everyday interest in the position of sand grains as bonded by colloidal materials cannot escape the importance of their peculiar behavior. Happenings so slight as to be ignored may be of profound significance to such particles.

For the foundryman, the most important colloid is clay. Other industries using far more clay than the foundry industry have long known that the ions attached to clay particles and the soluble salts found with them greatly affect the behavior of clay. Foundrymen have also known this as is witnessed by their differentiation between sodium (western) and calcium (southern) bentonite. However, other industries have gone one step further by adding chemicals to offset any change in clay due to process conditions, or even to change the behavior of the clay to gain some desirable feature.

Need for Additional Control

The foundryman realizes the need for some additional control to produce better castings with improved surface finish, and a relative freedom from scrap and extra work due to molding sand. This control can be had to a great degree by exercising care in the selection and treatment of those very small particles, the colloid binders in molding sand mixtures.

The foundryman makes a choice in the chemicals associated with his clay when he decides which clay to use; there are some soluble salts with this clay which give it properties desirable in his use. He then must be interested in improving or at least maintaining these properties throughout the life of the clay. To do this it is imperative that he be able to determine the kind and amount of chemicals associated with the clay,



Fig. 8—High-pH facing containing bentonite but no cereal rammed to high density, resulting in a mold surface that was easily displaced.

or sand mixture, at any stage of its life. For clays or molding sand mixtures analysis for these chemicals is a tedious process not adapted to routine control. There is, however, a backdoor approach through the use of pH value.

Meaning and Use of pH. Some molecules of water break apart (ionize) according to the relation:

TABLE 6—Effect of Soda Ash on Heap Sand

MIXTURE	pH Casting No.	After Mulling	Chemical Addition	Spec. Wt.,g	'O'H %	Perm.	Green Comp. St.,psi
Heap Sand.	0	Sand from heat, not mulled or tested.					
PROCEDURE	1	7.0	None	175	8.0	40	5.0
Mull 15-lb batches (except as noted) 3 minutes each, test, store overnight, make test molds. Jolt drag 25 times and finish off with butt rammer. Butt ram cope.	2	7.6	Soda Ash	177	8.2	30	5.3
	3	7.8	Soda Ash	177	8.1	40	5.6
	4	8.1	Soda Ash	175	8.0	35	6.9
	5	8.8	Soda Ash	175	8.2	40	6.5

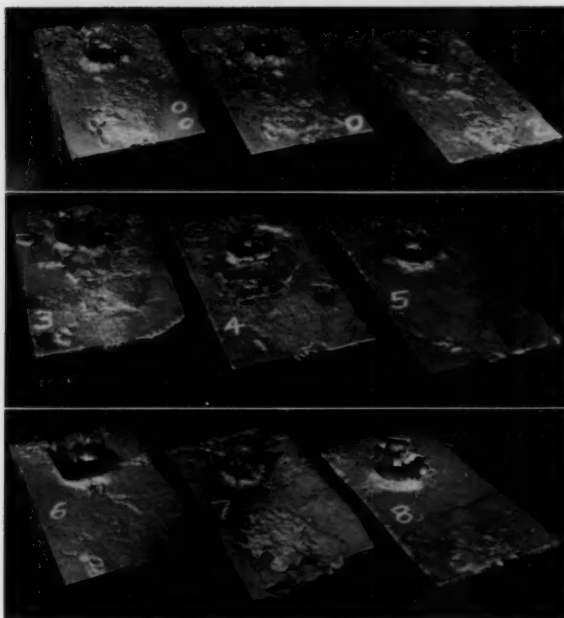
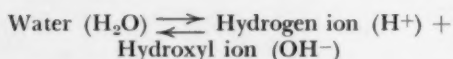


Fig. 9—Castings (cope, above; drag, right below) made in new facing containing fireclay (no bentonite or cereal) look similar to those in Figs. 7 and 8, but good castings were produced at lower pH. See Table 5.



It is obvious that when only water is present there must be an equal number of hydrogen and hydroxyl ions. All substances that dissolve in water also ionize to same degree and the presence of these new ions upsets the equal ratio of the hydrogen and hydroxyl ions. If this new balance favors hydrogen ions the solution is acid, the more hydrogen ions the stronger the acid. Conversely, if the hydrogen ions are suppressed, the solution becomes basic.

For determining the amount of chemicals present in a solution, the following reasoning is used:

1. The activity of hydrogen ions (H^+) in a solution can be measured.
2. The activity of hydrogen ions is greatly affected by the presence of other ions in the solution.
3. The degree of this effect depends upon both the kind and amount of these other ions.
4. Therefore, if it is known what ions—other than hydrogen ions—are present in the clay as purchased, and what ions may be introduced by use of the clay, it is possible to estimate their amount from their effect on the activity of the hydrogen ions.

Activity as used in this paper, means that the solution acts as if a given concentration of hydrogen ions were present. In a strict definition, it is the product of the concentration and the average effectiveness (called the activity coefficient). Thus,

$$A_H = C_H \times f_H$$

In this formula, $A_H = \text{H}^+$ Activity; $C_H = \text{H}^+$ Concentration; and $f_H = \text{H}^+$ Activity Coefficient.

How does one measure hydrogen ion activity? It is known that hydrogen ions carry a positive charge and go to the cathode of a wet cell battery. Suppose a wet cell battery is constructed with one of the electrodes shielded by a glass membrane that allows only the transfer of hydrogen ions. Then hydrogen ions will be the only positive ions (cations) that participate in creating a voltage across the cell. If the characteristics of the electrodes are known, this voltage can be used to define the activity of all the hydrogen ions in the cell fluid (the electrolyte).



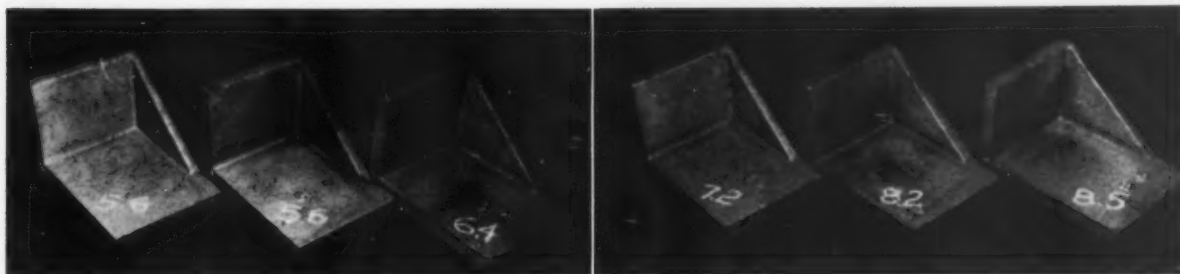


Fig. 10—Gray iron test castings stopped scabbing at pH 7.2, rough surface continued through pH 8.2 and 8.5.

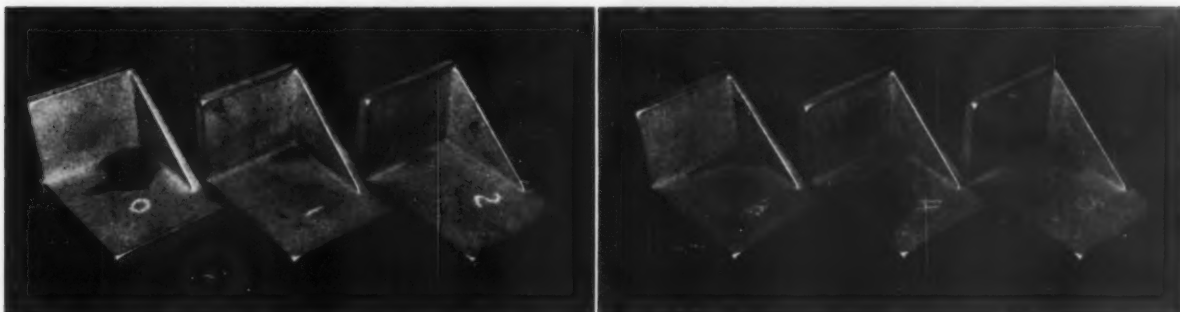


Fig. 11—Another gray iron series with scabbing reaching minimum at intermediate pH value. Refer Table 6.

The pH meter is constructed so that electrodes furnished with the instrument can be lowered into a clay-water or molding sand-water mixture, and, by using this mixture as the electrolyte, determine the activity of all the hydrogen ions associated with the clay or molding sand mixture merely by operating the dials.

The meaning of pH is:

$$\text{pH} = -\log A_H = -\log (C_H \times f_H)$$

It is interesting to remember that because a logarithm is in the defining equation, a change in the pH value of one unit, say, from seven for pure water to six for a weak acid, means a tenfold increase in hydrogen ion activity of the solution. The use of pH lies in the correlation of its measurement with the kind and amount of other ions in the electrolyte. This may be done in the laboratory or in the foundry.

Effect of Chemicals on Clay. One property of clay is its ability to stay in suspension in water and to form a more or less viscous slurry. Such slurries may be used to show that chemicals do affect clay properties. Figure 12 shows the Stormer instrument for measuring the viscosities of such slurries. The water clay mixture is placed in the cup, the cup is raised, and a cylinder is made to rotate in the slurry by the force of a falling weight. Larger weights cause the cylinder to rotate faster. A definite procedure must be established for these experiments to attain reproducibility. A procedure was established but is not described since the data presented are used only to show trends.

A plot of the revolutions per minute versus the driving weight gives a consistency curve that is a straight line for all but the lowest and very highest rpm. By extending the straight line portion of the consistency curve to the horizontal axis, the yield value is obtained. The true units are dynes per square centimeter but the area of the cup and cylinder are con-

stant so only the driving weight will be considered in this paper. This yield force is the portion of the total driving force necessary to initiate plastic flow.

The reciprocal of the slope of the straight line portion of the curve indicates the (coefficient of) plastic viscosity. Mathematically, this is defined as:

$$U = \frac{F - f}{dv/dr}$$

where U = coefficient of plastic viscosity; F = shearing force, dynes per square centimeter; f = yield value, dynes per square centimeter; and dv/dr = unit rate of shear.

Horizontal Line Shows Viscosity

In visual examination of the plots it is handy to remember that the closer the line approaches the horizontal position, the more viscous is the slurry. From such visual examination it may be observed that at lower pH values the yield values and viscosities are low. When the pH is raised by the addition of certain chemicals, both the viscosity and yield value increase to a maximum and then decrease with further additions. (Fig. 13 and 14). Figures 15 and 16 show this graphically. It may be seen that for the bentonite slurry, different basic chemicals with the same cation, sodium, change the pH value at which maximum viscosity and yield values occur. Also, the pH value for the maximum viscosities and yield values differ for the two clays using the same chemical, soda ash.

Those who wish to investigate the properties of slurries without purchasing a viscosimeter may follow the instructions in Fig. 17. The siphoning time gives some indication of the viscosity and the suspension of the sand reflects yield strength. A comparison of these curves with the experimental castings indicates that best results are attained at pH values that are at least

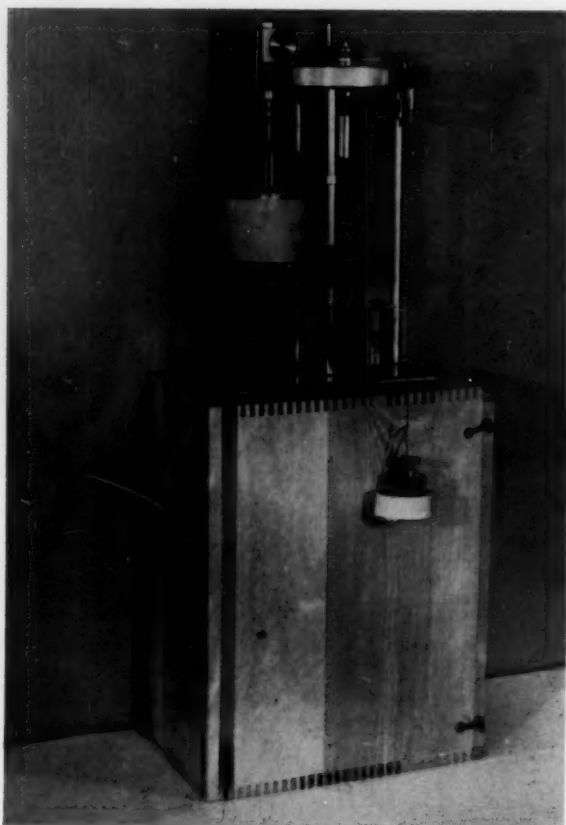


Fig. 12—Test instrument for measuring viscosity of clay slurries is powered by falling weight.

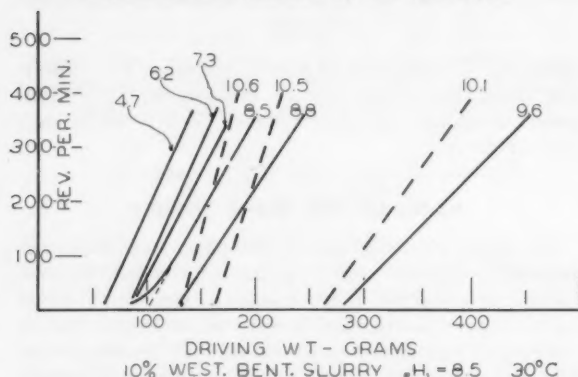


Fig. 13—Consistency of curves of 10 per cent bentonite slurries at various pH values, altered from initial pH of 8.5 by chemical additions.

high enough to reach the "plateau" area of the curves. This apparent correlation immediately raises two questions:

1. What is this effect of chemicals on clays that changes the behavior of slurries and molding sand mixtures?
2. Is it possible to correlate the behavior of clay in a slurry with clay in the sand mixture?

Diran and Taylor⁵ have directed attention to the necessity for considering the fundamental forces bonding clay particles and for considering that the cations associated with the clay greatly affect these forces.

In their discussion only the difference in the effect of the various cations was considered and this effect was assumed to be due solely to the degree of hydration and the resultant net attraction forces between micelles. The clay particle and its surrounding water hull is called a micelle.

Kaolin-Water Measurements

This assumption was based on the work of Johnson and Norton⁶ in which conclusions were drawn from "apparent viscosity" measurements of purified kaolin-water systems. Neither true viscosity nor plastic viscosity were measured as single point measurements were used. Green⁷ has since pointed out the danger of studying systems having yield strengths by any methods other than microscopic examination and the consistency curve. The original explanation may now be expanded.

Grim⁸ cites the work of van Olphen, Mering, and others showing that electron micrographs of montmorillonite prepared from sodium suspensions differ from those prepared from calcium suspensions. Sodium ions promote edge-to-edge bonding while calcium ions promote bonding between basal planes. At calcium ion concentrations below the exchange capacity of the clay, the relative strength between the two types of bonding so changes that aggregates have less tendency to form one flake on top the other and instead grow laterally. Not only distance between particles is changed; the geometry also changes. In commenting on their findings, Grim concludes in part:

"From the point of view of soil mechanics, this would be of tremendous importance, for it means that a very small amount of replacement of sodium ion by calcium ion, or *vice versa*, could cause a great shift of particle bond with a great change in physical properties."

Molding operations fall well within the scope of soil mechanics.

The degree of hydration, or swelling, that occurs is of importance. Clay mineralogists⁸ agree that the initial absorbed water is not liquid water. The water molecules are so oriented as to act in many respects as if they were part of the clay particle. Naturally, molecules farther away are less tightly held. As the water content of a mixture is increased, it becomes difficult to tell just when to consider a molecule as oriented or not. Fortunately, the foundryman need not worry over such technicalities. It is sufficient to know that in molding sand mixtures all, or very nearly all, of the water is non-liquid. This means that conclusions drawn from a study of slurries where free water is present must be handled cautiously in their application to sand mixtures.

Simplified Explanation

Pending further study, a simplified explanation of the effect of chemicals on molding sands will be restricted as follows: The ions present, both cations and anions, influence the bonding action of clays by changing the degree of hydration, the strength of the bond, and the geometrical orientation of the clay particles. The direct effect is one of determining green

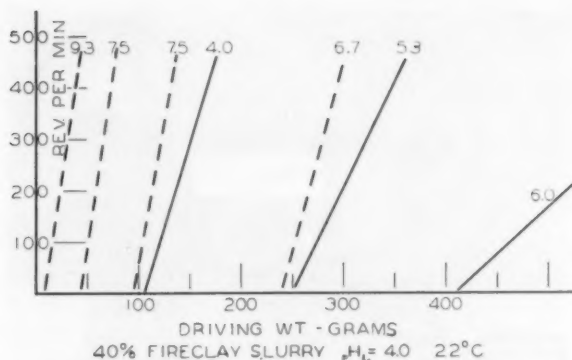


Fig. 14—Consistency of 40 per cent fireclay slurries as influenced by pH. Initial pH of mixture was 4.0.

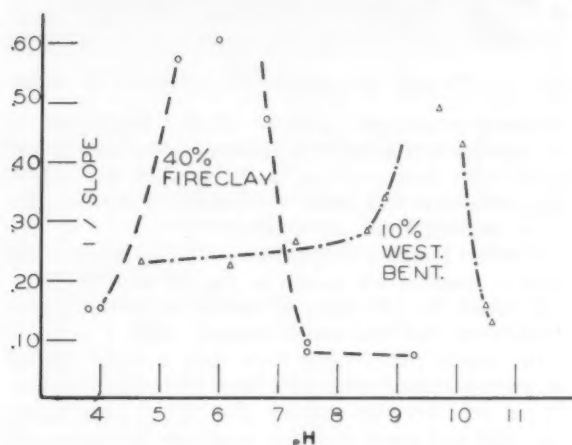


Fig. 15—Rise and fall of viscosity, as pH increases in fireclay and bentonite slurries.

and dry strength. The indirect, but equally important, effect is that of aiding or preventing the attainment of a thorough covering of the sand grains with a film of uniform thickness. At elevated temperatures, where the ionic bonding forces are destroyed, a film of uniform thickness will give the most effective viscous bond at the lowest temperature consistent with the particle size and composition of the clay. The importance of such bonding has been established.⁹

Practical Approach to Molding Sand. While the data has been restricted primarily to work with steel castings, experience with other foundries has proved pH control of chemical additions to be applicable to all sand casting production. In fact, any industry using colloidal materials in contact with water must consider this to secure optimum technical and economical results.

There is no escape. Every sand foundryman from time immemorial has, in some manner or another, either practiced such control or used special materials and/or special molding and casting practices to make up for the lack of control. Because every foundryman has engaged in such endeavor, it was inevitable that a great difference in practices arise from shop to shop. These variations exist today and prohibit any rigid "add this" or "do that" to get best results in every

shop. The only practical procedure for optimum results is a complete re-evaluation.

As the first step in an approach to molding sand, consider the influence of materials on the sand mixture:

1. Clays differ as to initial chemical content, the requirement for, and sensitivity to, chemical control. They differ according to type, from pit to pit for the same general type, and even within a given pit.

2. Cereal binders are also colloids and sensitivity to control changes with the manufacturing process. Cereals exert the additional influence of themselves affecting the pH of a sand mixture.

3. Water differs in the soluble mineral or chemical content.

4. Some organic chemicals found in certain "sand conditioners" give ions or molecules so large that bonding sites on the clay may be covered and rendered unavailable for ion exchange and bonding.

5. Wetting agents may be affected by or themselves affect the performance of other chemicals.

6. Mold washes may have been chemically treated by the manufacturer.

Operational Factors

Additional factors determined by the operating conditions and practices in any given shop that apply primarily to treatment of used sand include:

1. The pH of a sand mixture changes at a rate greatly determined by the decomposition of the organic material.

2. Where there has been no control, clay efficiency has been low. Increased efficiency may require lowering of clay additions.

3. Lack of conscious control may have brought about the use of additions that do affect pH. A foundry may now be practicing pH control without knowing it. This can occur either through the use of commercial additives or the use of western bentonite in sands bonded primarily with other clays.

4. The need of stabilizers and cushioning agents used to control mold density may change.

In view of the number of variables, first experimentation should be limited to simple mixtures. No preconceived ideas about how a sand should feel, or what laboratory properties it should have, can be allowed to influence the selection of mixtures.

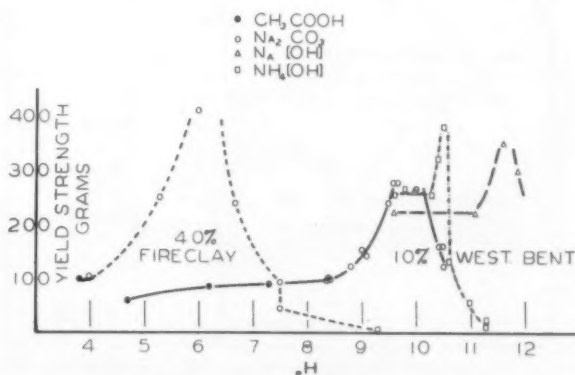


Fig. 16—Yield strength of fireclay and bentonite slurries increase, then fall off as pH increases.

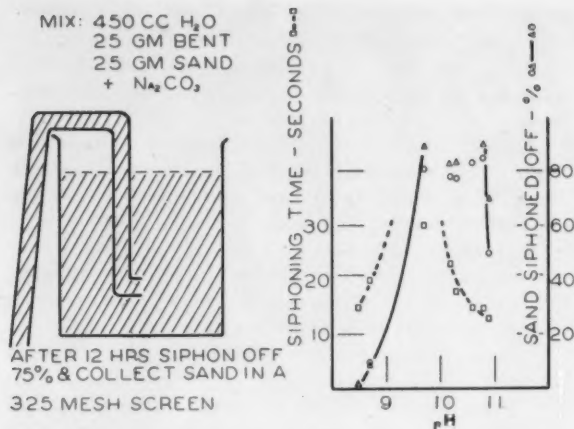


Fig. 17—Simple viscosity test (left), and plot of test results (right).



Fig. 19—Battery-operated research pH meter used at Unitcast Corp. laboratories.

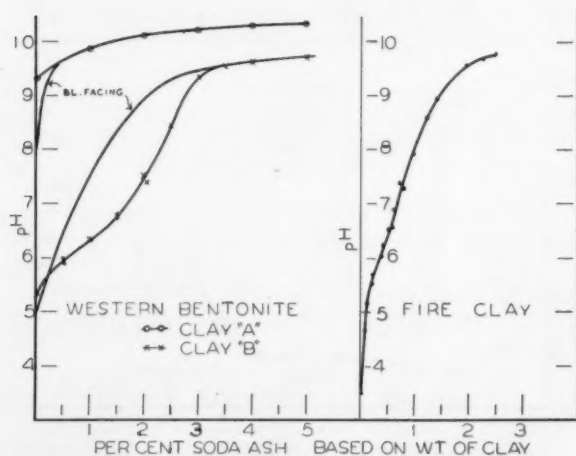


Fig. 20—Effect of soda ash on pH of bentonite and fire-clay-bonded sand mixture.



Fig. 18—Portable line-operated pH meter used by author.

Molding procedures must be closely supervised or the molder will adjust his practice to the feel of the sand. With these precepts firmly in mind, the following procedure will allow evaluation of the benefits to be derived from pH control:

1. Select a means for pH measurement. Instruments used at Unitcast are shown in Fig. 18 and 19.

2. Check the pH value of the clay or molding sand mixture at different concentrations until a point is found where pH changes little with a slight change in concentration. Ten per cent bentonite slurries, 40 per cent fire clay slurries, and 50 per cent bentonite-sand and water mixtures were used in this paper.

3. From data on slurries or molding sand and water mixtures, construct a pH versus per cent chemical curve as shown in Fig. 20. Measure the pH just after mixing and at intervals of several hours. This will give some idea of the amount of chemical to add to a sand mixture and the length of time needed for reaction. Total reaction is not needed to obtain a considerable change in properties.

4. Use a series of sand mixtures low in bond content and at different pH values.

5. Measure and record laboratory properties if equipment is available.

6. Make castings at various pH values from a pattern most susceptible to erosion and scabbing. Keep these castings for comparison with later series of higher bond contents.

7. Select the best sand mixture by examining the castings. Laboratory controls for sand properties may be established from the properties of this mixture. The only purpose of these laboratory controls is to help to reproduce the mixture that gave good castings.

This procedure will allow temporary attainment of good results. For permanent results it is necessary to consider the effect of this change in practice on the bulk of the sand in the shop. Sand not treated will change in pH value as treated sand is mixed in. Reused sands normally take smaller additions than were first made. Procedure at Unitcast required pH measurements on reused sand before mixing, clay pH, and the pH after mulling for each load. A few days

experience allowed the reduction of measurements to several a day requiring but about 15 minutes time overall.

One point remains and it is far from the least: The best pH level for the colloid binders may be used and poor castings may still be produced. Even the highest clay efficiency cannot compensate for too little bond, a poor sand distribution, loose molding practice, or faulty gating.

There is no escape from this phenomenon of nature. A thoughtful approach carefully supervised will allow its use to bring about the most economical production of high quality castings.

Conclusions

1. Molding sand mixtures are made up of small particles—sand grains and colloidal materials. Consideration of the special properties of small particles is requisite to sand control.

2. Clay is colloidal and chemicals may be used to control its behavior by changing the degree of swelling, the type and strength of bond formed, and the distribution of the clay.

3. The use of pH measurements to control chemical additions is an economical means for minimizing variations in sand performance and attaining a high level of casting quality.

4. No high degree of skill is required and no special equipment, other than a means for pH measurement, is necessary.

5. The effect of chemicals on colloids is a natural

phenomenon and foundrymen should put it to use rather than suffer from it.

Acknowledgment

The authors wish to thank Messrs. C. W. Taylor and J. G. Blake of Alloy Founders, Inc., for their cooperation in making the gray iron castings; Hein de Jong, Demka Steel Foundry, Utrecht, Holland, for the bentonite viscosity studies; and Ray Henry, Unit-cast Corp., for assistance with all the tests and the photography that make this report possible.

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Calendar of Future Meetings and Exhibits

March

4-5 . . American Society for Metals
Hotel Statler, Boston, Mass. Mid-Winter Meeting.

10-11 . . Foundry Educational Foundation
Hotel Cleveland, Cleveland. College-Industry Conference.

15-19 . . National Association Corrosion Engineers
Kansas City Municipal Auditorium. 10th Annual Conference.

16-17 . . Steel Founders' Society of America
Edgewater Beach Hotel, Chicago. Annual Meeting.

19-20 . . East Coast Regional Foundry Conference
Philadelphia, Pa.

25-26 . . American Hot Dip Galvanizers Association, Inc.
Netherland Plaza Hotel, Cincinnati. Annual Meeting.

April

5-7 . . American Institute of Mining & Metallurgical Engineers

Palmer House, Chicago. National Open Hearth Conference.

8-9 . . Malleable Founders' Society
Pittsburgh, Pa. Market Development Conference.

26-28 . . Chamber of Commerce of the United States
National Chamber Building, Washington, D. C. Annual Meeting.

26-30 . . American Society of Tool Engineers' Industrial Exposition
Convention Center, Philadelphia.

May

3-5 . . Air Pollution Control Association
Patten Hotel, Chattanooga, Tenn. Annual Meeting.

5-7 . . American Society of Training Directors
Schroeder Hotel, Milwaukee. Annual Conference.

8-14 . . AFS Convention & Exhibit
Public Auditorium, Cleveland.

17-20 . . Basic Materials Conference & Exposition
International Amphitheatre, Chicago.

June

13-18 . . American Society for Testing Materials
Hotels Sherman and Morrison, Chicago. Annual Meeting.

14-15 . . Malleable Founders' Society
Seignior Club, Quebec, Canada. Annual Meeting.

July

13-15 . . Western Plant Maintenance Conference & Show
Pan Pacific Auditorium, Los Angeles.

September

13-25 . . First International Instrument Congress & Exposition
Philadelphia Convention Hall, Philadelphia, Pa.

November

1-5 . . National Metal Congress, National Metal Exposition
Palmer House, Chicago.

Shell Molds

For Titanium Castings

R. M. LANG / Principal Met., Non-Ferrous Metallurgy, Battelle Memorial Institute, Columbus, Ohio

■ Much of the research on the casting of titanium has been confined to casting into molds machined from graphite^{1, 2}. High-quality, contamination-free titanium castings have been made in graphite molds, but there are several disadvantages to the use of this type of mold. Graphite molds are expensive to prepare, have a short life³, and must be preheated to fairly high temperatures at the time of casting¹ to obtain freedom from cold shuts, seams, and other chill defects. These disadvantages of graphite molds led to research at Battelle, sponsored by Frankford Arsenal, on the development of an inexpensive, expendable mold material³.

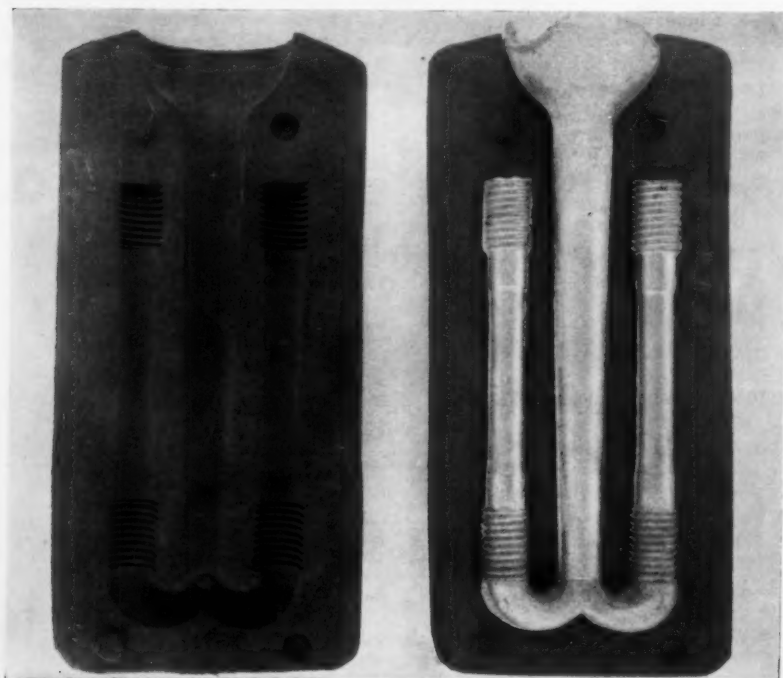
Titanium step castings with sections ranging from 1/8 to 2 in. in thickness were made in shell molds



R. M. Lang

composed of refractory oxides³. These castings, which weighed about 1 3/4 lb, had rough surfaces full of deep pinholes when made in unwashed zircon molds. Castings made in silica molds had deep pinholes and were much rougher than those made in zircon. Metallographic examination revealed that the surface of these castings was contaminated to a depth of at least 0.001 to 0.018 in. Hardness traverses on cross sections of the castings showed, however, that the contaminated layer was actually 0.030 to 0.040 in. thick, with the heavier sections having the greater depth of contamination. This hard layer of contaminated titanium decreases the over-all ductility of the casting and is difficult to remove by machining.

Because castings made in machined graphite molds show no evidence of mold reaction, it was thought that a graphite wash, applied to the shell mold, might eliminate mold reaction. Various types of graphite



Use of zirconium oxychloride wash on shell molds for titanium castings has been shown to improve surface finish and drastically reduce amount of pinholing. Over-all depth of contamination has not been proved markedly superior to other washes.

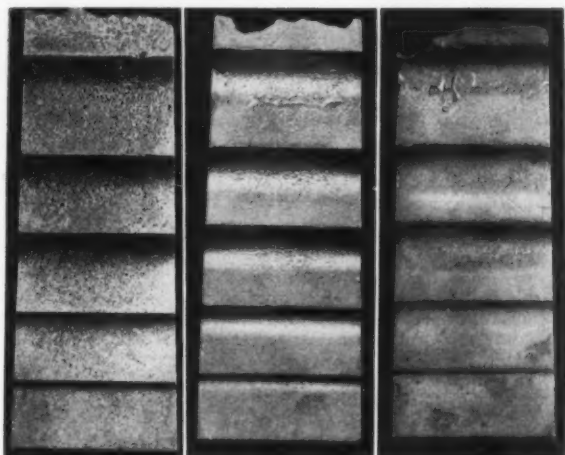


Fig. 1 (left)—Titanium cast in an unwashed silica shell mold. 1X. Fig. 2 (center)—Titanium cast in a silica shell mold washed with zirconium oxychloride. 1X. Fig. 3 (right)—Titanium cast in a zircon shell mold washed with zirconium oxychloride. 1X.

washes were tested extensively^{4, 5}. None of the washes tested, however, had any appreciable effect on reducing mold reaction.

Research on new types of mold binders⁵ revealed that castings made in zirconia molds bonded with zirconium oxychloride were practically free of pinholes, and that the surface of the castings was contaminated to a lesser degree than those made in previous mold materials other than graphite. To test the effect of zirconium oxychloride on reducing mold reaction in shell molds, a zirconium oxychloride wash was prepared from a mixture of 90 per cent (by volume) saturated aqueous solution of zirconium oxychloride and 10 per cent ethanol. Several silica shell molds were washed with this mixture by brushing the solution onto the mold face until the surface of the mold was saturated.

Better Surface Finish

Titanium, prepared under an argon atmosphere in a skull-melting furnace⁶, was cast in these molds after they were baked at 450 F for 1 hr. The resulting castings had a much better surface finish and less pinholing than castings made in unwashed or graphite-washed silica shell molds. There were no pinholes in sections 1 in. thick or less, and there were pinholes only at the re-entrant angles of sections larger than 1 in.

Photographs illustrating the difference between a casting made in an unwashed silica shell mold and a shell mold washed with zirconium oxychloride are shown in Fig. 1 and 2. A casting made in a zircon shell mold washed with zirconium oxychloride had a somewhat better finish than the one made in the washed silica shell mold. The appearance of this casting is shown in Fig. 3. Casting in a washed zirconia mold resulted in a finish similar to that obtained in a washed zircon mold.

Contamination of a titanium casting by the mold material increases the hardness in the surface of the

casting. This relationship made it possible to measure relative contamination by making Knoop hardness traverses on cross sections of the castings. Data from these measurements, presented in the form of curves in Fig. 4, 5, 6, and 7, show that, in sections of the step casting less than 1 in. thick, the casting made in the washed mold was considerably less contaminated than the casting made in the unwashed mold. Although the degree of contamination of the casting made in the washed mold was much less than that of the casting made in the unwashed mold, the depth of contamination was about the same in both.

Inch Sections Less Contaminated

The hardness curves show that the 1-in.-thick sections of the castings were contaminated to a slightly lesser degree than the $\frac{1}{2}$ -in.-thick section which was cast in the unwashed mold. This anomaly may be attributed to the fact that cold metal was poured into the 1-in.-thick sections of the mold. Because in skull melting it is impossible to maintain the bath at a uniform temperature, the last metal poured is always near its freezing point. The step castings were poured so that the larger sections filled last. Thus, the metal filling the larger sections was colder than that in the smaller sections. One might speculate from this that if the melt temperature had been uniform, the 1-in.-thick sections probably would have been contaminated to a greater degree than the $\frac{1}{2}$ -in.-thick section.

The zirconium oxychloride wash appears to be ineffective in reducing the contamination of sections of the casting which are 1 in. thick or thicker. This apparent ineffectiveness may be merely an indication that the zirconium oxychloride wash on the 1-in. section had been destroyed before the mold was cast.

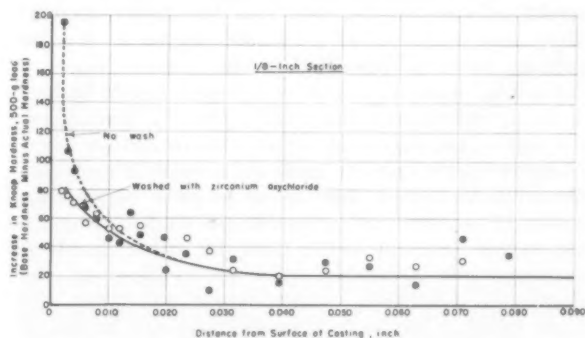


FIGURE 4. HARDNESS TRAVERSE MADE ON TITANIUM CAST IN SILICA SHELL MOLDS

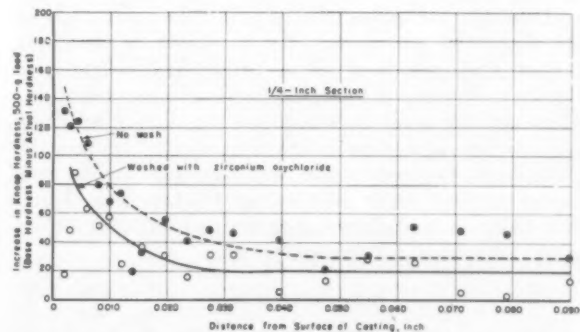


FIGURE 5. HARDNESS TRAVERSE MADE ON TITANIUM CAST IN SILICA SHELL MOLDS

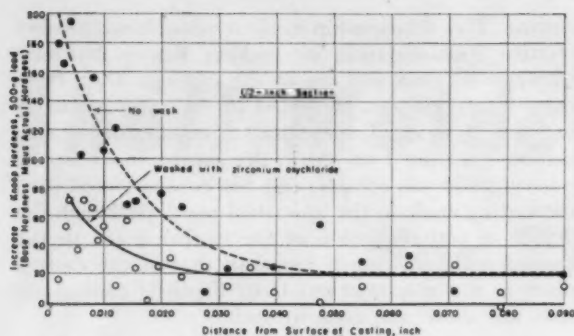


FIGURE 6. HARDNESS TRAVERSE MADE ON TITANIUM CAST IN SILICA SHELL MOLDS

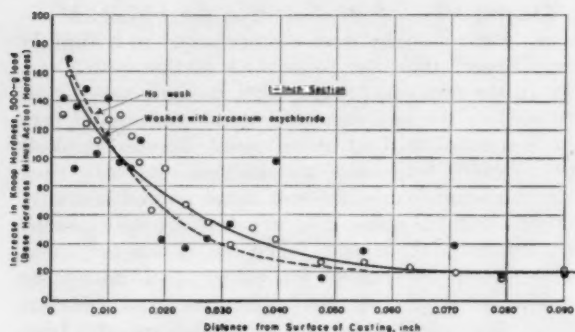


FIGURE 7. HARDNESS TRAVERSE MADE ON TITANIUM CAST IN SILICA SHELL MOLDS

One of the inherent disadvantages of a tilting, skull-melting, arc furnace is that, just before pouring, the mold is momentarily exposed to intense radiation from the arc. Larger sections of the mold which are closer to the furnace are exposed to more radiation than the smaller sections. This intense radiation may decompose the zirconium oxychloride wash, which could account for the fact that the larger sections were contaminated to the same degree as similar sections made in unwashed molds.

Castings made in zircon or zirconia molds washed with zirconium oxychloride also show a marked reduction in the degree of surface contamination when compared with castings made in unwashed molds of these base materials. The surface finish of the castings made in washed zircon molds or washed zirconia molds was generally better than the surface finish of castings made in washed silica molds. However, the degree of subsurface contamination was about the same in all of the castings made in washed molds.

Conclusions

Although the zirconium oxychloride wash reduces the degree of subsurface contamination of titanium cast in shell molds of silica, zircon, and zirconia, it does not decrease the over-all depth of contamination. However, the wash does improve the surface finish of the casting and drastically reduces the amount of pinholing. Washed zircon and zirconia molds give better surface finish to castings thicker than 1 in., but have no superiority over washed silica molds in terms of subsurface contamination.

Acknowledgments

The author expresses appreciation to Frankford

Arsenal for permission to publish the results obtained on the work sponsored under Contract No. DA-33-019-ORD-223. Acknowledgment is also given to Messrs. J. G. Kura and J. H. Jackson of Battelle, and R. E. Edelman and H. Markus, of Frankford Arsenal, for their guidance and suggestions.

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Pat Dwyer Dead at 79



Pat Dwyer

Foundrymen throughout the industry were saddened to learn of the death on January 9 of Pat Dwyer, closely associated with the foundry field for over 60 years.

Born in Ireland in 1875, Pat arrived in Nova Scotia, Canada, ten years later, became a foundry apprentice at 16. After five years as journeyman molder in various Canadian and U.S. foundries, he re-

turned to Nova Scotia where he worked as foreman of the iron, brass and steel foundries of the Dominion Iron & Steel Co., Sydney, for nine years. He later served as superintendent of the Sydney Foundry & Machine works for a similar period.

Dwyer is best known in the metals casting field for his work with *THE FOUNDRY* magazine, with which he was affiliated from 1919 until his death. He used his keen wit, humor and philosophical common sense to add zest to his "Adventures of Bill," a feature of the magazine for more than two decades. He also authored many technical and practical articles in the magazine, and his book, "Gates and Risers for Castings," has gone through several editions. In addition, Pat was a gifted speaker and lectured before many foundry groups in all sections of the country.

In recognition of his many and extensive contributions to the foundry industry, Pat was awarded an Honorary Life Membership in AFS in 1942.

Methods for Special Pipe Production in Australia

G. J. BENSON / Instructor in Charge of Metal Foundry, Melbourne Technical College

Production of gray iron pipe and fittings for irrigation are described in this Official Exchange Paper from the Australian Branch of the Institute of British Foundrymen. Written discussion of this paper, Convention Preprint No. 54-54, should be sent to American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5, Ill. The paper will be presented at a Gray Iron Session of the AFS 58th Annual Meeting, Cleveland, May 8-14, 1954.

■ Australia covers an area nearly equal to that of the U.S.A., but the total population does not exceed 8½ million people. Victoria, the smallest mainland state has a population of 2½ million; Melbourne, the capital, 1¼ million—half the state's population. Australia is not provided by nature with high snow-clad mountains, or large rivers, and the conservation of water is of vital importance to the whole community.

Victoria is probably the most fortunate of the main-

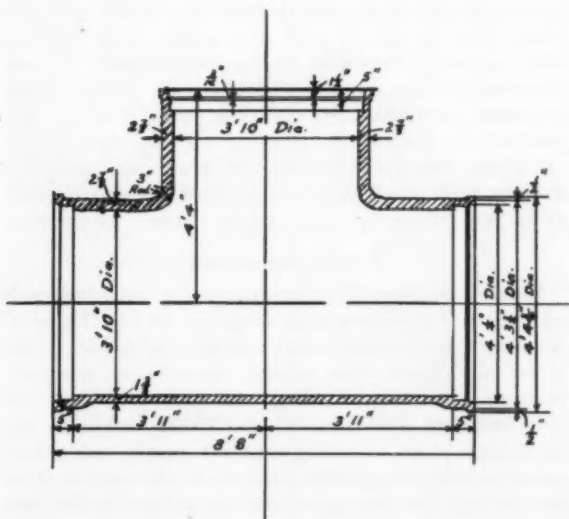


Fig. 1—Cross section of five-ton faucet tee pipe to be molded with strickles.

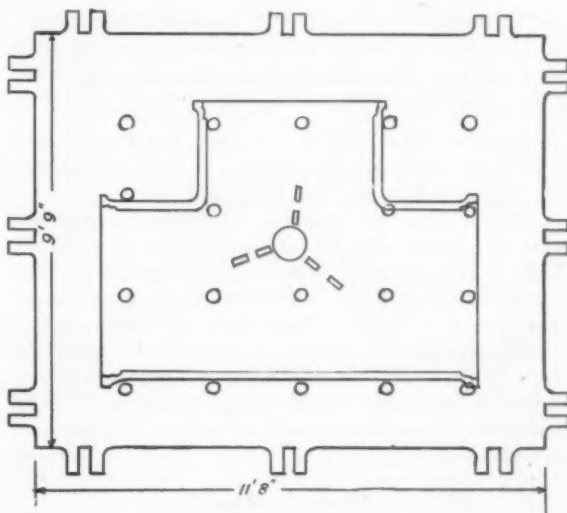


Fig. 2—Hold-down plate with tee pipe superimposed to shown positioning in mold. Pipe is part of irrigation pumping system used in Australia.

land states in regard to water supply; Melbourne enjoys an adequate supply of pure soft water, piped to the city from strictly controlled watersheds 50 to 60 miles away in forest clad hills. The country towns usually draw their water supply for domestic and irrigation from rivers which are locked by dams and weirs. The main bodies responsible for the supply of water to the community are the State Rivers & Water Supply Commission, catering for country towns and all irrigation projects in the state, and the Melbourne & Metropolitan Board of Works, controlling the supply of water for Melbourne.

Pump Irrigation Required

A considerable portion of the state is irrigated by gravitation, but in some parts pumping is necessary, and thus the call comes for castings of the type to be described. The number of castings is usually small,

which limits the number of foundries handling this type of work. Two types will be described:

1. A 48-in. internal diameter faucet tee pipe, tested to withstand a 300-ft head of pressure. This pipe is molded by the frame and strickle method, as termed in Australia.
2. A flanged 90° bend pipe, 54-in. ID, metal thick-

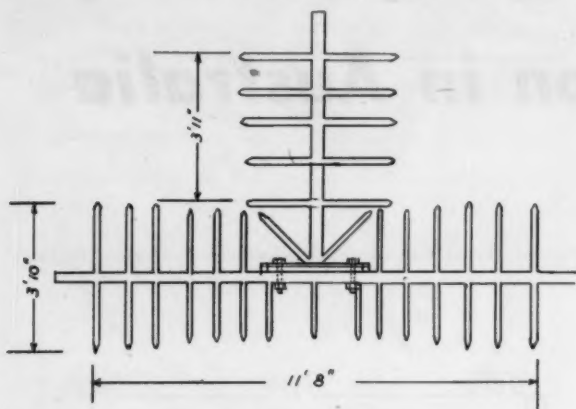


Fig. 3—Complete core arbor for tee pipe.

ness of body $1\frac{1}{8}$ in. required for low-pressure irrigation pumping systems. This pipe is molded using a shell skeleton pattern.

Only six or seven foundries in Melbourne and one other outside are able to handle this class of molding. When it is considered that the tackle for a 5-ton (all weights based on 1 ton = 2000 lb) casting may weigh $15\frac{1}{2}$ tons it will be realized that the production of a small number of castings is costly. Some foundries keep in stock tackle such as hold-down plates and loose box sides; this would reduce costs considerably. However, the author intends to assume that no suitable tackle is available.

Faucet Tee Pipe

Estimated weight of the faucet tee shown in Fig. 1, allowing for a slight gain in thickness by using strickles is approximately 5 tons. Thickness varies from $2\frac{7}{8}$ in. on the joint line to $1\frac{3}{8}$ in. on the bottom and top. All the tackle needed is cast in open sand.

Bottom Hold-Down Plate. A hold-down plate measuring 12 ft x 10 ft x 3 in. thick with a suitable number of lugs, and lightening holes, and provision for rigging for spindle work is first cast (Fig. 2). The weight of this plate would be approximately 5 tons. This plate is permanently set in the foundry floor at a depth suitable for general heavy work. Hook bolts of a length sufficient to cater for a number of different jobs are held in position by a toggle, convenient dimensions being $1\frac{1}{4}$ in. dia. x 12 ft long, with the end in the floor in the shape of a hook. The author has found that screwed ends rust quickly and cause trouble later.

Core Iron. A suitable core arbor (Fig. 3) is then cast, the estimated weight of the casting being $4\frac{1}{2}$ tons. It must be rigid to prevent any spring during pouring, and is most conveniently made in two sections so that it may be reclaimed for future use. The two

branches are molded separately with the aid of a number of loose pieces (Fig. 4). After setting the frame (Fig. 7) level in the foundry floor, usually on the hold-down plate to save floor space, the mold for the core iron is rammed up, starting from the one end and continuing until the straight iron is complete. About 18 in. length is allowed for each print, making provision for securing the branch and providing lifting and bearing ends. (See Fig. 4, right).

New Wings Formed

As the wings and center piece are rammed, they are successively withdrawn and placed further along to form new wings. The branch is then molded by the same process, and the arbor is assembled in the cleaning department. (All the tackle required is made and assembled with very little aid from the machine shop.) With this type of core iron, there should be ample clearance at the sides, and the iron should be about 2 in. shallower than half the internal diameter of the pipe. This allows for wedging under the cope and also assists in minimizing contraction stresses.

Cope. The cope (Fig. 5) is molded in another section of the foundry. The sides, ends, and bars are all cast in open sand; the bolt holes take $\frac{3}{4}$ in. bolts and are oval. The pattern equipment consists of a simple open frame with bolt-hole prints set on 9 in. centers. Estimated weight complete is approximately $6\frac{1}{2}$ tons.

Faucet Patterns. To save pattern costs, the six half patterns for the faucets of the pipe are struck up (Fig. 6) and split with a $\frac{3}{16}$ -in. mild steel plate. The dowel pins are cast in, the tapered end of the dowel

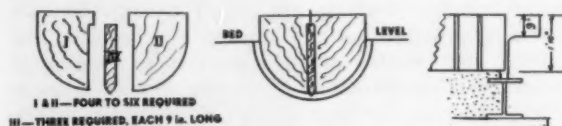


Fig. 4—Pattern equipment for core arbor. At right, method of supporting.

pin protruding through a drilled hole in the splitting plate. This is coated with a graphite wash on one side, and roughened with a diamond-pointed chisel on the other so that the metal will bite on. This method provides six half-faucet patterns, which, while not precise, are sufficiently accurate for the desired application. (Small bosses on the faucet for securing straight mild steel pipes are marked off and bedded in after striking up, and before drying the molds.)

Pattern Equipment

Molding the Pipe. The pattern equipment consists of a frame and strickle boards as shown in Fig. 7 and 8. A suitable hole is excavated and the hold-down plate is set and hook bolts placed securely in position. Bearing irons are measured and placed so that the cope and core iron transfer their entire weight to the hold-down plate, ensuring that the sand is not called upon to take any of the load. It is also essential to ensure that the core irons can be wedged under the flange of the cope box; short pieces of H-girders (obtained from the fabrication shop scrap heap) are generally used as bearers.

Should it be desired to leave the hold-down plate permanently in the foundry floor, it is suggested that a coke bed 4-6 in. thick be placed upon the plate and vent pipes led to the joint line. After preparing the bed, the mold frame is set in position, making sure that it is dead level. This is important, since the half-faucet patterns are set, with the aid of a level, at right angles to the frame. The mold is next rammed up to floor level using a medium grain size sand.

In Melbourne, Oakleigh Red Sand, a uniform natural sand of AFS Fineness No. 45 containing 12-15

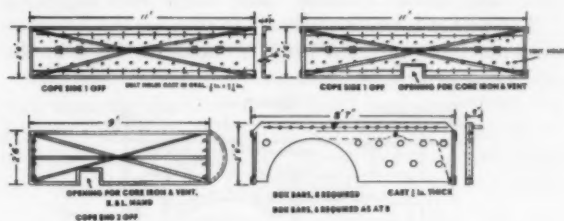


Fig. 5—Detail of flask sides and flask bars.

per cent AFS clay is used, the prepared sand having the following typical properties: Moisture, 5-6 per cent; Permeability, 50-100; Green Compression Strength 8-9 psi. For this type of work the author uses about 5-6 per cent of organic material such as sawdust in the sand to counteract sand expansion defects and increase the collapsibility of the core and allow the casting to contract.

Inside Strickle Saves Time

Bottom and Core. Some molders strickle first to the outside dimensions and then strickle on the metal thickness. The author however, prefers to strickle to the inside (core) measurements on the bottom, since this saves time. The bottom is therefore strickled to the core dimension, using half strickles on the radii of the tee. The frame is staked with small stakes and after removing the end cross pieces, the core iron is tried and the bearings adjusted so that there is at least one inch clearance below the bottom of the core iron.

After removing the core iron, wet paper or wet parting sand is placed on the mold and a layer of facing sand is placed on top of the portions. The core iron is replaced after clay-washing, the three end pieces of frame are replaced and the bottom half of the core is rammed using hookers or gagers where necessary. Blocks are inserted between the core iron bars of such

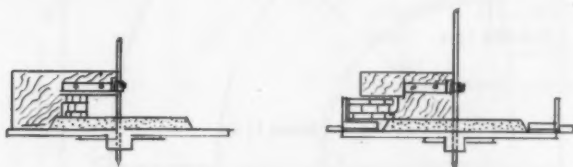


Fig. 6—Strickles for cast iron faucet patterns.

a size that when rammed up to the joint line the thickness of core sand is limited to about 12 in. The cavities left by the withdrawal of the blocks are now vented and rammed up with coke or cinders. The coke and cinders are then heaped up above the core iron until

10-12 in. only remains for sand to be rammed. (The author uses metallurgical coke which is later reclaimed.)

The three top half-faucets are now set in position and their alignment is checked carefully. After splashing the coke with clay wash (not too thick) the top half of the core is rammed, in this case, to the outside diameter of the body of the pipe. The area between the faucets and the print ends is next struck off.

Must Sit Firmly

After removing the frame, making the joint line, and coating with a suitable parting, the built up cope is tried on, checking carefully that it sits firmly on the bearers. Four down gates of 1 1/4 in. diameter are placed on each side of the body core. The runners are cut in the bottom prints and three ingates from each down gate are cut into the mold. Providing care has been taken in the preparation of the facing sand and mold, very little, if any, nailing or sprigging in front of the runner is necessary with the sands available in Melbourne.

Cope and Finishing. The cope is now rammed up, using gagers where necessary, and is staked securely. Then the cope is lifted off. Using the provision made on the flask for turning without undue jerking, it is

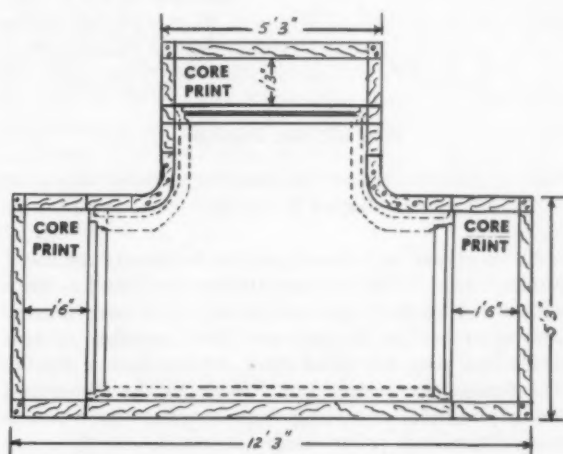


Fig. 7—Frame for strickling tee pipe.

rotated and then finished, ensuring that clearances are cut along the joint lines and around the prints, and taking risers off each faucet. In finishing, the author prefers a block of cork and only uses a steel sleaker after the graphite wash has been applied, finally brushing with a fine brush using a light wash.

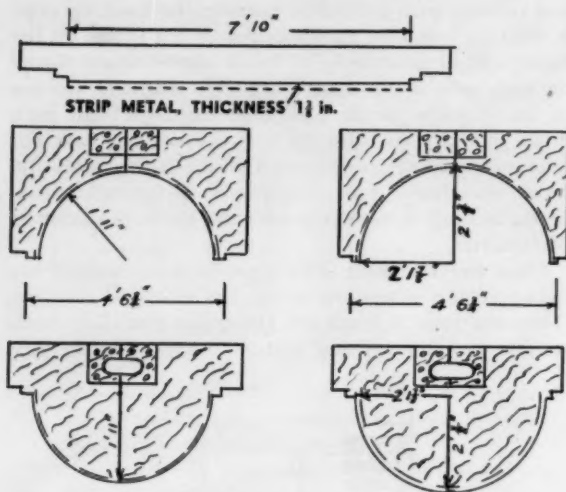
Not Always True Mate

The frame is now replaced and the metal thickness struck off the top of the core. In some of these pipes where the branch runs into the body, the half strickle will not always mate. If so, the section should be sprigged first so that in cutting away with the trowel the metal thickness can be checked carefully. The three half-faucet patterns are lifted off and the end pieces of the frame are removed, preparatory to lifting out the core.

The author prefers to lift the core just off its bearers with the aid of the turnbuckles and then remove it completely with the electric crane. The core is placed on an oven truck and finished and dried carefully. The advantage of the large amount of coke in the core now becomes apparent; it not only lightens the core, but aids the drying and later assists in the contraction of the casting.

The end pieces are replaced on the frame and the metal thickness is struck off the bottom. The three

STRICKLE FOR STRAIGHT SIDE (BOTTOM AND TOP)



STRICKLES FOR BRANCH

Fig. 8—Strickle boards for use with frame shown in Figure 7 (p. 67).

half-faucets are withdrawn and the bottom of the mold finished in a similar manner. After the cope has been stiffened a litt' by partial drying, it is turned over and again set on the bottom. The assembly is now dried by a portable mold drier. Seldom is any trouble experienced in closing molds made by the frame and strickle method, providing clearances have been cut on joint lines and prints and that thickness clays are used. There is always a slight gain in metal thickness when using this method but this may be concentrated by making the core strickle boards 1/32 in. "full" and the mold strickle boards 1/32 in. "under".

Set Girders on Bearers

After closing the mold, making up the runners and riser heads, securing the vents and joints against possible run-outs, girders or stout rails are set on bearers on the cope and the whole screwed down securely. The core iron is finally secured by wedging between the bottom flange of the cope and the core iron.

Pouring and Cleaning. Figure 9 shows a sectioned mold set up ready for pouring. The composition of the metal is approximately: total carbon, 3.3 per cent; silicon, 1.5–1.75; manganese, 0.6–0.8; phosphorus, 0.4–0.6; and sulfur, 0.05. The pipe is poured from two ladles at 2480 F (approx.).

After casting, runner heads and risers are removed, the end plates of the cope are unbolted and removed

and the casting is eased around the faucet, especially at the joint line. After easing, the ends are replaced to prevent cold air from playing on the exposed casting. The casting is removed from the sand when it is cool enough to handle comfortably, the top half of the core is dug out, and the core iron is unbolted so that each section can be reclaimed for further use if required.

Dimensions of the flanged bend pipe are shown in Fig. 10. A shell skeleton pattern made in halves is used. This type of large pattern must be handled with care, since "winding" may occur very easily.

The tackle is made similarly to that for the previous example but provision must be made to support the

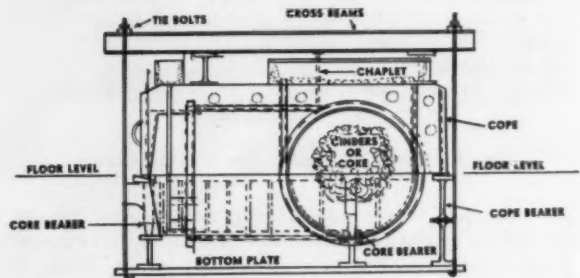


Fig. 9—Mold and core assembly ready for pouring pipe tee for irrigation system.

core without the aid of chaplets. The core iron (estimated weight 4 1/2 tons) is therefore cast with a balancing arm (Fig. 11 and 12) using the same holding down plate as in the previous example. Owing to the thin metal section, the green strength is reduced and the percentage of organic material increased in the sand for the top half of the core.

To counteract the tendency in large bend pipes for the core to spring or lift slightly at the bend while

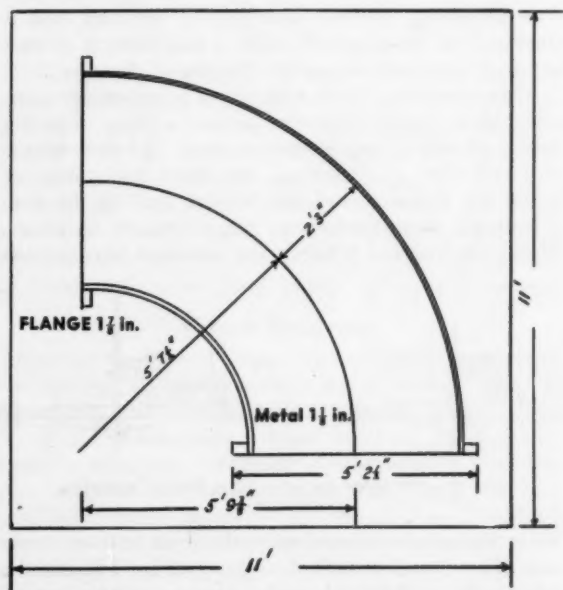


Fig. 10—Flanged bend pipe to be made with skeleton pattern.

casting, the author builds up in the center of the core bearers to take a stout chaplet (Fig. 13). A dry pine section is inserted about 1½ in. below the top of the core; the remaining 1½ in. is built up to the face of the core with a steel or cast iron disc. After casting, the pine section chars and thus eliminates the risk of a contraction crack at the chaplet. This chaplet, which is wedged down from under the cross holding girders or rails, is not intended to prevent the whole core from lifting, but is only a precaution to take up any slight spring that may occur during pouring.

Support Prevents Twist

The same molding procedure is followed, taking care that the pattern is set level and supported to prevent any twist or winding and that all bearings sit in their correct position. It is possible to use the cope side of the tee job, casting separate bars to follow

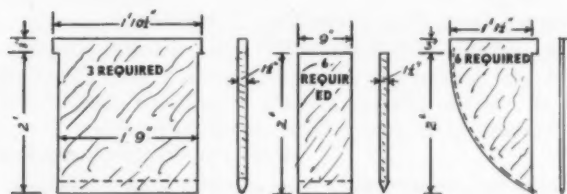


Fig. 11—Pattern equipment for core arbor of bend pipe.

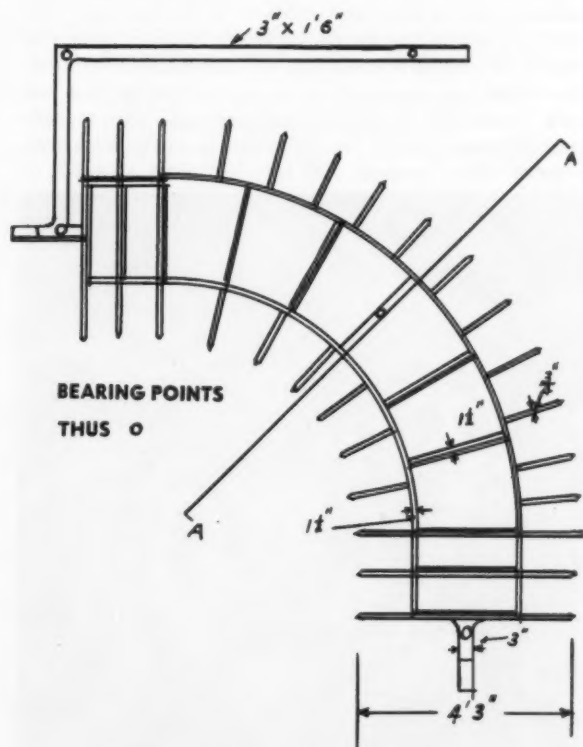


Fig. 12—Core arbor for bend pipe, showing balancing arm at top of drawing.

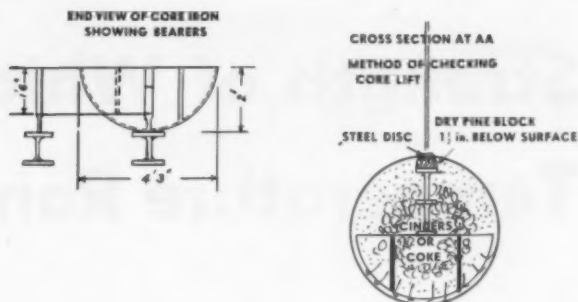


Fig. 13—How "spring" is avoided in bend pipe core during casting. Section AA refers to Figure 12.

the contour of the bend. The author prefers to keep the flasks rectangular or square even though this may require more ramming. However, it is possible to block off a section if so desired. The numbers required do not warrant special boxes to follow the contour of the pipes; in many cases they are also more awkward to handle.

Similar Procedure

Assembly and casting are as for the previous pipe. After casting, all bolts are eased, cope ends are removed and the core eased. The cross bars adjacent to the inside of the flangers are unbolted and withdrawn with the aid of the crane. With a light sectioned large pipe, as soon as the casting is sufficiently cool for men to work on it, the inside of the core is further eased out and the casting is then left in the sand before removal until it has nearly reached room temperature. The estimated weight of the bend pipe is between 3.3 and 3.4 tons.

Strickle boards are eliminated by using a shell skeleton pattern, but the extra cost of the pattern must be taken into consideration. The flask sides usually are retained, but after the castings have been in service for a specified period the core irons and flask bars are broken up for scrap. This prevents the accumulation of large quantities of tackle unlikely to be used again, since it is rare for an exact duplicate to be ordered.

Conclusion

The cost of producing the type of casting described is high and unless a number of castings are required competition from fabricated sections is fairly keen. The number of jobbing molders capable of molding this type of work as well as marking out the tackle necessary are all too few. In this era of rapid expansion of mechanized foundries, founders must not lose sight of the importance of jobbing work and must continue to train men in this highly specialized art. Such training also fits men admirably for responsible positions in mechanized shops.

Acknowledgments

The author wishes to thank Messrs. A. N. Waterworth and G. P. Day for their assistance with the diagrams, and to Messrs. A. W. Silvester and H. A. Stephens for reading and criticizing the paper.

Strength of White Irons in the Temperature Range of Hot Tearing



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Tensile strength of white irons studied varies from nothing to several hundred pounds at temperatures of 2030—2200 F; contraction of a few thousandths of an inch can cause complete tearing. Written discussion of this paper, Convention Preprint No. 54-48, should be sent to American Foundrymen's Society, 616 S. Michigan Ave., Chicago 5, Ill. The paper will be presented at a Malleable Session of the AFS 58th Annual Meeting, Cleveland, May 8-14, 1954.

■ In studying the hot tearing of castings, the strength of the metal at temperatures in the temperature range of tearing is a matter of fundamental importance. This paper presents some data on the tensile strength of white irons at temperatures where hot tearing is most likely to occur in castings.

Strength in Liquids-Solidus Range. During the first stage of their solidification process, white irons consist of a mixture of very strong dendrites of austenite, and molten metal. Depending on carbon and silicon content of the iron, about 50-90 per cent of the iron is frozen as austenite of high strength before the eutectic begins to freeze. The extent of this dendritic primary austenite in occupying a major portion of the mass and structure of the iron is illustrated in Fig. 1. It is necessary to know whether the mixture of austenite and liquid has appreciable strength above the solidus temperature, the temperature where all freezing is completed on cooling. Tensile strength of white iron in the liquidus-solidus temperature range was therefore studied.

High temperature properties can be studied by different methods. Tensile tests might be run at appropriate temperatures on bars cooled from the liquid state. Or, white iron bars could be heated to a temperature between the liquidus and solidus and ruptured in tension. Still another method consists of heating

white iron bars under a constant load until a temperature is reached which results in fracture. The latter method was employed because of the simpler laboratory techniques involved.

Commercial white iron tensile test bars of 0.625-in. diameter were heated while under tensile load in a tubular globar furnace. Method of loading and mechanical set-up are shown in Fig. 2. The furnace was sealed to prevent oxidation. A chromel-alumel thermocouple was attached to the surface of the test bar and protected from radiant energy temperature measurement errors by covering it with refractory cement. The furnace and test bar were allowed to

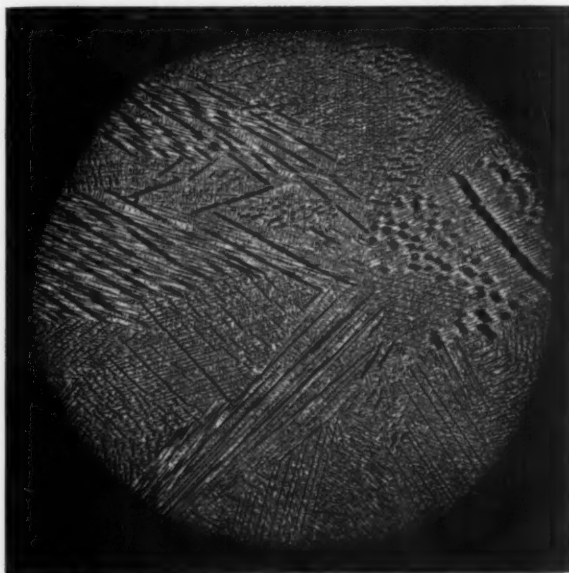


Fig. 1—Dendritic structure of white iron in 0.500-in. dia. cross-section of hot tear casting. Metal etch, 8X.

heat from room temperature to a temperature above the solidus, i.e., in the solid-liquidus melting temperature range.

With the bar under constant tensile load, the temperature of the furnace was increased until the bar fractured. A typical heating curve is shown in Fig. 3. The curve reveals that the eutectic melting temperature range was substantially exceeded before the bar broke under a load of 10 psi. The thermocouple attached to the bar faithfully indicated the eutectic melting temperature range. Rupture occurred with a brittle, dendritic appearing fracture. Results of the temperature of rupture as related to tensile loading are presented in Table 1 where chemical analyses of the bars are also reported. The white iron test bars studied were obtained from three different commercial foundries.

Initially, tests were performed on bars of one analysis (bars 1 through 8) to eliminate composition variables. The bar was quenched in water directly from the temperature of rupture. The quenched bar was then examined metallographically to determine whether liquid metal existed across the entire section of the bar. Figure 4 shows the typical mixture of liquid metal (areas showing as a white eutectic network in Fig. 4) and solid austenite (dark areas) which existed at the temperature of rupture.

Temperature gradients across the test bar sections were thought to be a possible source of error in the load vs. temperature of rupture methods of determining strength in the liquidus-solidus range. Accordingly several bars loaded in the same way were tested at different heating rates to see if a possible temperature gradient effect could be detected. Heating rates in the liquidus-solidus range of 2 to 40 F per minute were studied. No effect of heating rate on temperature of

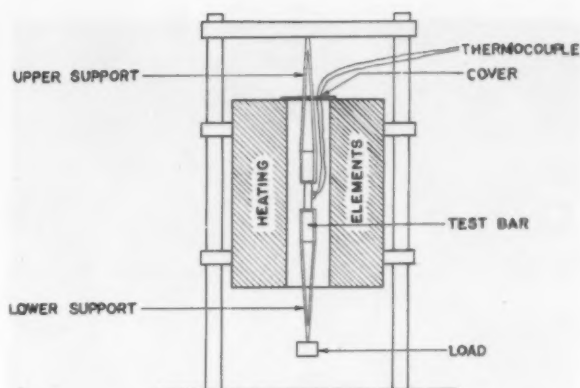


Fig. 2—Schematic diagram of experimental equipment for testing strength in liquidus-solidus range of white iron.

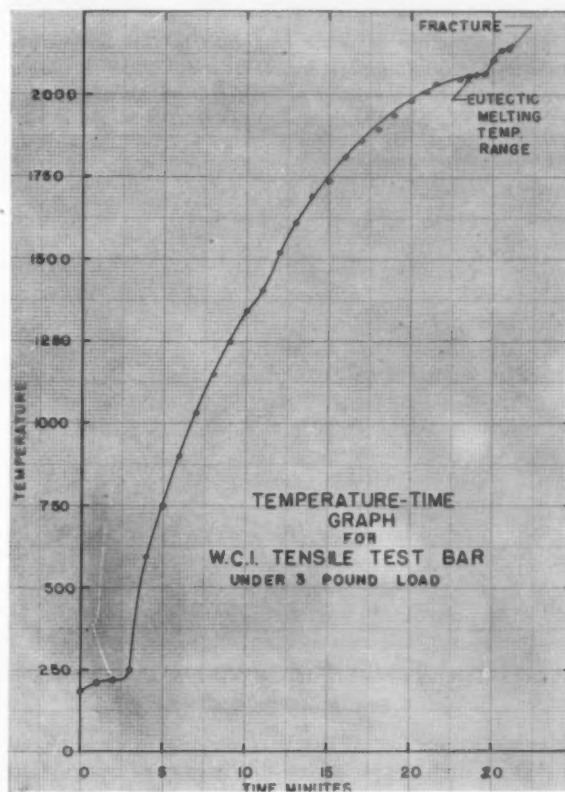


Fig. 3—Temperature-time curve of white cast iron test bar heated in equipment shown in Fig. 2. Note that eutectic melting range is clearly exceeded before breaking of test bar under three-pound load.

rupture at constant load could be found, so it was concluded that any possible temperature gradients within the test bars were not a significant factor influencing the results presented in Table 1.

The simplest relationship existing in the data of Table 1 is that shown in Fig. 5. The temperature of rupture was first plotted as a function of the log of the applied tensile stress for test bars 1-8 as shown in Fig. 5. These bars were of one white iron analysis—2.24 per cent carbon, 0.91 per cent silicon. Then the

TABLE 1—TEMPERATURE OF TEARING UNDER CONSTANT TENSILE LOAD

No. Bar	Metal Analysis						Applied Stress, psi	Temp. of Rupture, F
	C	Si	Mn	P	S	Others		
1	2.24	0.91	0.45	0.140	0.13	....	10.0	2140
2	"	"	"	"	"	"	10.0	2195
3	"	"	"	"	"	"	10.0	2205
						Ave. Bars 1-3	10.0	2180
4	"	"	"	"	"	"	20.0	2150
5	"	"	"	"	"	"	32.6	2126
6	"	"	"	"	"	"	57.5	2111
7	"	"	"	"	"	"	81.5	2063
8	"	"	"	"	"	"	118.0	2063
9	2.48	0.97	0.34	0.135	0.12	0.10 Cu 0.01 Cr	57.5	2121
10	"	"	"	"	"	"	57.5	2100
						Ave. Bars 9-10	57.5	2110
11	2.47	0.98	0.33	0.13	0.118	0.09 Cu 0.01 Cr	57.5	2106
12	"	"	"	"	"	"	57.5	2101
						Ave. Bars 11-12	57.5	2104
13	2.44	0.92	0.33	0.130	0.112	0.086 Cu 0.01 Cr	57.5	2101
14	"	"	"	"	"	"	57.5	2101
						Ave. Bars 13-14	57.5	2101
15	2.90	1.30	0.48	0.128	0.15	....	60.3	2111
16	"	"	"	"	"	"	60.3	2097
						Ave. Bars 15-16	60.3	2104
17	2.67	1.24	0.46	0.128	0.15	....	50.7	2111
18	2.60	1.25	0.48	0.128	0.15	....	50.7	2111

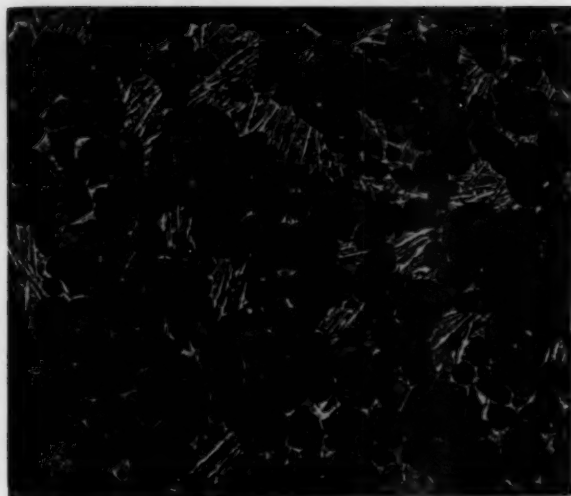


Fig. 4—Structure of white cast iron in test bar water-quenched from temperature of tearing, 2150 F. Light areas and network existed as molten metal at moment of quenching. Metal etch, 150X.

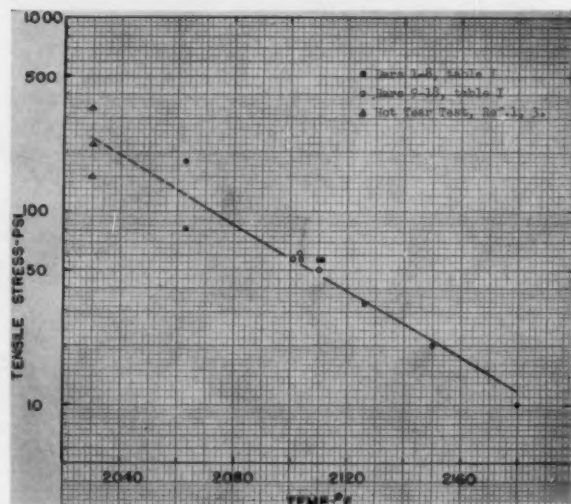


Fig. 5—Temperature of rupture of white iron bars under a constant tensile stress.

average values for all the bars varying in carbon and silicon contents were added to the graph. It is evident from Fig. 5 that white iron has substantial tensile strength in the liquidus-solidus temperature range and that this strength increases with decreasing temperature. That the strength should increase logarithmically with decreasing temperature is not unexpected

since calculations based on the iron-carbon diagram show that the percentage of solid primary austenite increases logarithmically with decreasing temperature down to the eutectic freezing range.

Liquid Decreases Strength

That there should be any strength whatever between the liquidus and solidus may be surprising. Recent work indicates that many alloys have no strength when the least bit of liquid metal is present throughout the microstructure. However, white iron is drastically different from solid solution alloys in its freezing mechanism and the austenite dendrites formed have very high strength. Mechanical interlocking of dendrites alone, Fig. 1, could develop strength of the order measured. Liquid film strength is another possible source of strength in the liquidus-solidus range. Actually, there is no fundamental reason why some mixtures of solids and liquids cannot develop strength. In view of data obtained and the relationship in Fig. 5, it appears that white irons do have definite measurable strengths in the liquidus-solidus temperature range, a strength which depends on the temperature in that range.

Effect of Composition. Irons of several compositions were tested to determine the temperature of rupture under an applied tensile stress of 50-60 psi. Bars 9-18 in Table I present these data. It was thought that higher carbon irons would be substantially weaker at 2100 F than low carbon irons. However, the data for bars 9-18 plotted in Fig. 5 show only slight, if any, effect on strength for the analysis ranges studied. The authors are at present unable to explain this. Perhaps if lower applied tensile loads had been utilized, 10-20 psi for example, so that rupture would occur at a higher temperature, the effect of higher carbon and silicon percentage in the iron might then become pronounced.

Tearing Temperature during Cooling. In conjunction with an AFS malleable iron research project, the temperature of hot tearing during freezing of a specially loaded test bar was determined. The test bar referred to is shown in Fig. 6 and is one designed specifically for a hot tear testing method.¹ The bar, cast in core sand, is loaded in tension as it solidifies and contracts. The tensile stress necessary to cause complete tearing of the bar is determined and this value is used as a measure of the resistance to tearing offered by the metal. Tensile stresses required to cause such tearing in white irons have been found to be in the range of 150-600 psi, depending on analyses and other metallurgical factors.^{1, 2, 3}

The temperature of tearing of the bar at the point of fracture was also studied. Thermocouples inserted

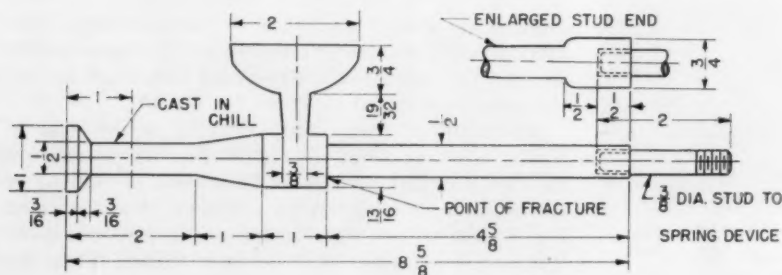


Fig. 6—Hot tear casting used to study tearing resistance of white cast iron. Casting is poured in core sand mold positioned in testing apparatus by procedure described in reference 1.

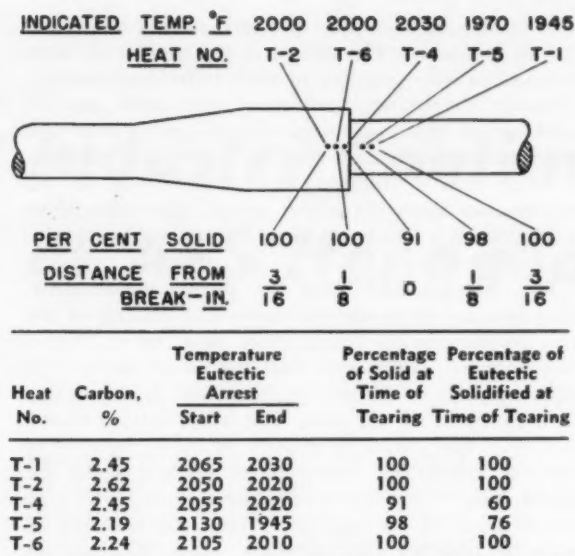


Fig. 7—Temperature and percentage of liquid remaining at time of tearing of white iron test bar shown in Fig. 6. Carbon content given in diagram above. Balance of analysis: 1.30% Si, 0.46% Mn, 0.15% S, 0.12% P.

in the test bar showed that tearing of the white iron occurred during freezing of the eutectic. The temperature and also the percentage of solid metal at the time of tearing is shown in Fig. 7. The metal temperature at the point of fracture (T-4) was always in the eutectic freezing range when tearing occurred.³ Some typical strength values for white irons of 2.20-2.30 per cent carbon 1.20-1.30 per cent silicon, obtained with the hot tear testing apparatus, are plotted in Fig. 5 at the appropriate temperature, 2030 F. It can be seen that the strength values obtained with the hot tear testing apparatus on test pieces cooling from the liquid state are in the same range as those obtained by the dead weight tests on bars reheated from room temperature.

Temperature of Hot Tearing. From the tensile data in Table 1 and the relationship plotted in Fig. 5, it is evident that white iron castings can be stressed over a considerable temperature range, 2200 F to about 2020 F, when liquid metal is still present. If applied stresses—from mold, cores, or gating for instance—exceed the strength at any temperature, hot tears will result. Hence, the temperature of tearing may be anywhere in the aforementioned range, the metal being weakest at the highest temperatures, of course.

However, upon cooling below the solidus temperature, strengths much greater than shown in Table 1 or Fig. 5 are developed. These strengths exceed the capacity of the testing equipment and are therefore not considered in this paper.

Discussion

The factors which influence hot tearing may be classified in two principal groups: (1) Inherent characteristics of the metal, and (2) External factors not properties of the metal.

Hot tearing factors which are inherent properties of the metal are: (a) Strength and ductility of the

metal in the hot tearing temperature range, and (b) Contraction of three types—liquid, liquid-solid, and solid contraction with decreasing temperature.

Hot tears occur only when stresses are produced in the metal which exceed its strength and ability to deform in the hot tearing temperature range. Stresses which cause a hot tear arise from restraint of the normal contraction propensities of the metal. In order that stresses may be developed, the metal must have attained a certain amount of strength during cooling and some condition of restraint must be imposed. It is at this point that the second group of factors producing hot tearing comes into play—those external to the metal.

External Factors

External factors include: (a) Restraint of metal contraction caused by the mold or cores, (b) Restraint of contraction caused by the casting itself or its gating system, and (c) Temperature gradients or hot spots operating in conjunction with restraint of contraction. These three factors are functions mainly of mold materials and construction, design of the casting and its gating system, and the temperature gradients which may exist. They are all factors separate from the inherent characteristics of the metal.

Metal Factors. Data in this paper show that the tensile strength of solid-liquid iron mixtures may vary from nothing to high over the temperature range 2200-2030 F. It is therefore evident that a tear may develop at any temperature in the range when stresses applied by external conditions exceed the strength at that temperature. Since such stresses are usually developed from restrained contraction of the metal, it follows that any variation in contraction of the iron is another exceedingly potent factor in influencing the tendency for tearing.

Earlier work¹ has shown that there are marked differences in the contraction characteristics of various irons. At a tearing temperature of about 2030 F, the total amount of contraction necessary to cause complete tearing of the 9.625 in. long test bar of Fig. 6 was found to be in the range of 0.0025 to 0.0100 in., depending on carbon content of the irons analyzing about 1.30 per cent Si, 0.45 Mn, 0.15 S, and 0.12 P.

Contraction Rate

At least as important as the amount of contraction is the rate at which this contraction develops. Rapid contraction favors rapid development of contraction stresses. As reported previously,¹ the rate of contraction of the test bar of Fig. 6 was found to be markedly affected by carbon content of the iron as shown in Fig. 8. It would appear that an iron of lower contraction rate would build up stresses less rapidly and therefore perhaps permit cooling of the iron to lower temperatures and greater strengths without a stress build-up that would cause tearing. It also appears in Fig. 8 that white iron under load contracts more slowly than it does when it is free to contract normally.

Contraction rate becomes especially important if one remembers that cores and molds require time for heating and collapse under the forces of the contracting castings. A good example of the importance

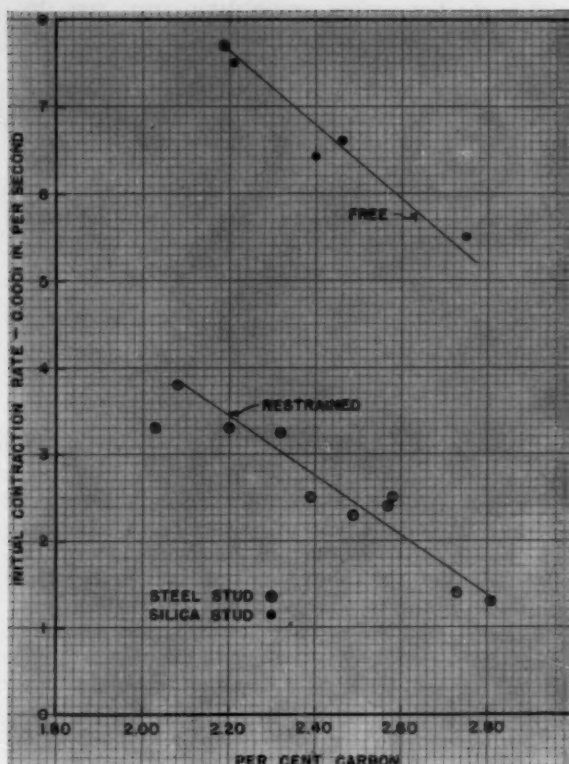


Fig. 8—Graph of total contraction rate of casting shown in Fig. 6 as a function of percentage of carbon in the iron. Upper curve gives effect of carbon content on contraction of freely contracting test bars. Lower curve gives contraction rate of test bars restrained at load equivalent to one pound per each 0.0001 in total contraction of casting. Iron analysis: 1.20-1.30% Si, 0.45% Mn, 0.15% S, 0.12% P.

of contraction characteristics in influencing tearing tendency is provided in an iron which freezes mottled or gray. Contraction is then greatly decreased and tearing does not occur.¹ Another good example of the profound influence of contraction rates is offered by the influence of dissolved hydrogen on tearing in the test piece of Fig. 6. Evolution of hydrogen during freezing causes a marked decrease in contraction rate of the iron. This is accompanied by a much higher strength at the tearing temperature.²

Two Important Factors

Hence, tearing as it occurs in castings involves both high-temperature strength and contraction characteristics of the metal. One must consider any particular tearing problem in the light of both these important metal factors. It is therefore true that any testing procedure which considers only one of the properties is inadequate.

External Factors. The mold, gating, and design of the casting itself are important factors influencing the generation of stresses in a freezing and contracting casting. These factors may vary so greatly that they may be regarded as the principal unknowns in hot tearing. Casting design and gating, of course, are peculiar to a particular casting. They therefore

must be treated separately for each casting when hot tearing is studied. The design of the mold and cores is therefore also peculiar to each individual casting. However, the materials of mold and cores may be common to many castings. Significantly, over the temperature range 2200-2030 F, the tensile strength of white irons in changing from zero to over 500 psi encompasses strengths which are of the same order of magnitude as the hot compressive strength of molding and core sands.

The time element enters this picture significantly, since heating of molds and cores and cooling of the iron to the tearing temperature must occur over a time interval. Cores may collapse in 30 seconds to eight minutes or longer, at 2000-2500 F, depending on ingredients of the sand. The small casting shown in Fig. 6 was found to require 46 to 57 seconds to develop measurable strength on cooling from the liquid state, the time interval being longer in high carbon irons (57 seconds for 2.61-2.70 per cent carbon irons of 1.30 per cent silicon¹). Large castings, depending on their mass and surface area relationships, may require time intervals of many minutes before they solidify sufficiently to develop strength.

During heating, cores may expand from zero to 0.010 in. per inch or more before they begin to collapse. Such expansion is sufficient to rupture the iron if it occurs when the iron is in its low strength condition at temperatures in the liquidus-solidus range. On the other hand, if the core has been heated to temperatures so that its collapse has begun before the iron begins to freeze sufficiently to become coherent, then tearing is less likely. Development of a tear is even less likely if the core can collapse at a rate equal to or exceeding the contraction rate of the iron, providing the core is the cause of the tear.

Another case may be readily visualized in which the cores and molds play no part at all in the tearing problem. A spread-out casting having a hot spot at one place on its periphery could be an example. Contraction of the casting periphery causing a pull on the hot spot would produce a tear even with the weakest core or molding sand. In this case, the casting design may overshadow any effects of mold materials, metal analysis, or melting practice.

Extensive discussion of mold, core, and casting factors influencing hot tearing of white iron is not the intended purpose of this paper. However, the authors desire to caution against any over-simplified interpretation of the data in Table 1 and Fig. 5 or simplified application to hot tearing problems in castings. The foregoing discussion section emphasizes the many factors which may need to be considered in analyzing hot tearing in practical casting.

Bibliography

1. E. A. Lange and R. W. Heine, "A Test for Hot Tearing Tendency," *TRANSACTIONS, AFS*, vol. 60, pp. 182-196 (1952).
2. E. A. Lange and R. W. Heine, "Effects of Melting Furnace Atmospheres on Fluidity, Hot Tearing Tendency and Other Properties of Malleable Iron," *TRANSACTIONS, AFS*, vol. 60, pp. 169-181 (1952).
3. E. A. Lange and R. W. Heine, "Effects of Melting Furnace Atmospheres on Casting Properties and Annealability of Malleable Iron," *TRANSACTIONS, AFS*, vol. 61, pp. 107-130 (1953).

Industry Continues Support of AFS Headquarters Fund

THE Building Fund for the new AFS Headquarters Building and Foundry Technical Center at Des Plaines, Ill., continued to grow in January. At the end of the month, the total stood above the \$227,000 mark in a solicitation that has received enthusiastic support from the foundry industry and its associated educational and research organizations.

Contributions received during the period, January 5-25, 1954, are listed below. Where the asterisk (*) is used, a contribution additional to an earlier one is indicated.

Algoma Steel Corp., Ltd.	Sault Ste. Marie, Ont., Can.
Alloy Steel Products Co.	Linden, N. J.
American Blower Corp.	Detroit
*American Brake Shoe Co.	New York
*American Cast Iron Pipe Co.	Birmingham, Ala.
*Atlas Foundry Co.	Detroit
David W. Boyd,	
Engineering Castings, Inc.	Marshall, Mich.
Canadian Refractories, Ltd.	Montreal, Que., Can.
Cedar Heights Clay & Coal Co.	Oak Hill, Ohio
*Central New York Chapter	Syracuse, N. Y.
Detroit Gray Iron Foundry Co.	Detroit
Engineering Castings, Inc.	Marshall, Mich.
Eureka Mfg. Co., Inc.	Wyandotte, Mich.
General Grinding Wheel Corp.	Philadelphia, Pa.
*Walter Gerlinger, Inc.	Milwaukee
Lawrence C. Gleason	Rochester, N. Y.
Globe Iron Co.	Jackson, Ohio
*Grede Foundries, Inc.	Milwaukee
Hanna Furnace Corp.	Detroit
R. E. Hard, St. Louis Coke &	
Foundry Supply Co.	St. Louis
Harrison Steel Castings Co.	Attica, Ind.
Industrial Iron Works	Portland, Ore.
Institute of Scrap Iron & Steel, Inc.	Washington, D. C.
Interstate Supply & Equipment Co.	Milwaukee
*Jackson Iron & Steel Co.	Jackson, Ohio
*Webb L. Kammerer, Midvale Mining &	
Mfg. Co.	St. Louis
*Robt. C. Kane, Midvale Mining &	
Mfg. Co.	St. Louis
*Charles C. Kawin Co.	Chicago
Kelsey-Hayes Wheel Co.	Detroit
*Lone Star Steel Co.	Dallas, Texas
E. J. McAfee	Bremerton, Wash.
*Messmer Brass Co.	St. Louis
Northwest Furnace & Foundry Co.	Portland, Ore.
*Pacific Steel Casting Co.	Berkeley, Calif.
Pacific Steel Foundry Co.	Portland, Ore.

Pennsylvania State College,	
Student Chapter AFS	State College, Pa.
*Perfect Circle Corp.	Hagerstown, Ind.
Albert E. Rhoads, Engineering	
Castings, Inc.	Marshall, Mich.
Kenneth W. Rhoads, Engineering	
Castings, Inc.	Marshall, Mich.
*St. Louis Coke & Foundry Supply Co.	St. Louis
*Semi-Steel Casting Co.	St. Louis
David E. Sherman, Engineering	
Castings, Inc.	Marshall, Mich.
Sibley Machine & Foundry Corp.	South Bend, Ind.
*Southern California Chapter, AFS	Los Angeles
Stearns Foundation, Inc.	Milwaukee
Tyler Pipe & Foundry Co.	Tyler, Texas
Universal Engineering Co.	Frankenmuth, Mich.
Western Foundry & Mfg. Co.	Springfield, Ohio
Western Foundry Co.	Portland, Ore.



New AFS National Headquarters and Foundry Technical Center at Des Plaines, Ill. had begun to take definite shape at end of January. Brick, steel are going up.

Practical Questions and Answers

Standard Sieve Sizes

We have lately discovered among our various customers using AFS sieves for testing size and distribution of sand grains, that they are not all using the full series and many are using different coefficients for calculating the Grain Fineness Number. Would the absence of certain sieves, such as No. 40, 50, and 70 make a great difference in the result?

The omission of sieves from the standard series (for AFS sand testing use No. 6, 12, 20, 30, 40, 50, 70, 100, 140, 200, 270, and pan) will affect results, whether expressed in terms of per cent retained on the various sieves or in terms of the Grain Fineness Number. The standard series should be used and you can do your customers as well as yourself a service by educating them to the advantages of securing data that may be compared with information now in the literature and in common use instead of accumulating meaningless data.

Jolt Squeeze Molds

We have several questions regarding the use of jolt squeeze molding machines. What size flasks should be used? Should they be snap flasks or regular? Should the molds be made with single or double face match plates? What is the average production to be expected from various types and sizes of molds?

There is little doubt that a tight flask is superior to either slip or pop-off types. However, in this day of high speed operation and keen competition, we have adopted the latter two types for general use. The advantages are many; the cost of one flask and jackets is much less than that of a great number of tight flasks; only one flask has to be maintained; shakeout is simplified with tremendous saving in labor.

We do not like to use flasks larger than 12 x 18 in. or 14 x 16 in., with 10-in. overall height of mold. Flasks of this size give the molder about 100 lb to place on the molding floor. If he sets out 100 molds per day, he has

handled a considerable weight. Also, the narrow mold is easier to draw and close. If sand is shoveled, 80-100 molds per man is a very good rate. The number of cores to be set is a point for consideration. If sand is hoppers, production should be 140-160, again depending on the cores to be set.

If two machines are used—one man making the cope, the other the drag—it does not necessarily follow that they will produce twice the number of molds. The advantages are in the saving to the man and the superior control in making molds, resulting in truer casting, more uniform weight, and cleaner casting.

Cope and drag pattern equipment will cost about one-third more than a double face match plate set-up.

We have found that production from a brass foundries averages about 10-20 per cent lower than a gray iron plant.

O. F. WEISS
Milwaukee Foundry
Div., SPO, Inc.
Milwaukee

Yellow Brass Contaminant

About once every six months we receive complaints that our line of yellow brass specialty fittings will not tin or take solder. It has been suggested that we might occasionally get too much chrome or nickel into the melt from plated brass scrap. For cost reasons we cannot use ingot as all our competitors are also using brass scrap. Would this chrome and nickel affect the soldering properties? Also, do you believe that metal poured at extremely hot temperatures might affect the tinning quality of the ferrule?

The most logical answer seems to be the presence of aluminum contaminant, which could have two sources. First, the yellow brass scrap contains a high percentage of aluminum bronze or manganese bronze. Second, the foundryman is probably adding aluminum in the same way, and for the same reason, that many melters of yellow brass use it, but may be adding too much. So often this is the case. A man wants a size 8 shoe, but a size 9 feels

so good that he buys a 10. Thus, an aluminum addition of 0.05 per cent is adequate to reduce zinc losses but many people use 0.1-0.25 per cent for no other reason than that they do not wish to take the time for accuracy.

If the operator will take about a half-pound of molten brass from the crucible and splash it on a concrete floor so that a thin wafer of metal is formed, and if he will examine the underside of the wafer and find a characteristic silvery sheen of aluminum, he will know that he has too much aluminum in the melt. He can remove it by using a commercial material prepared for this purpose and which is available from any number of flux suppliers.

Alloy Iron

What is the best method for formulating the original metal addition and the loss factor at 2650 F metal temperature, with iron containing 1.50 per cent molybdenum, 0.75 per cent nickel, and 0.50 per cent chromium. We use 50 per cent return scrap containing the same alloy. We have no nearby laboratory facilities and two or three days are required for a test return.

In the first place, it would be unwise to undertake the production of alloy cast iron to exacting specifications without the availability of a chemical laboratory for daily analyses. Five analyses per eight-hour shift are not excessive where iron is being cast to close specifications.

Nickel is not oxidized in coupola melting. Since there are no losses from oxidation, you can safely assume that 100 per cent of the nickel charged will be recovered in your gates and risers.

Nickel is usually added to the ladle when producing alloy irons containing less than 2 per cent of this element. "F" nickel shot containing approximately 92 per cent nickel is the most commonly used ladle addition.

Chromium, on the other hand, is subject to oxidation in coupola melting. Loss will vary with the melting technique used. For instance, a liberal coke ratio and a mild blast will result in low chromium loss; whereas, the

use of less coke and a high blast volume will cause more oxidation. When good melting conditions prevail, recovery of 90 per cent of the chromium charged can be anticipated.

Ladle Addition

The percentage of chromium you require would indicate that this element be added in the ladle. A number of ferro alloys are available for this purpose. It is desirable to obtain a highly soluble grade of ferrochrome. If the material contains both manganese and silicon, solubility and recovery tend to be enhanced, particularly under adverse conditions.

Since molybdenum oxide is reduced by molten iron, the recovery is high. An average of 95 per cent can be anticipated when using ferromolybdenum. The iron should be at a relatively high temperature before making the alloying additions, which should be made at the spout, where the temperature is highest.

There is one other serious handicap when alloying additions are made in the ladle: the difficulty of estimating accurately the volume of metal without ladle scales. Molten cast iron can be considered to weigh 400 lb per cu ft, or 0.23 lb per cu in. If your ladles are carefully lined to pre-determined dimensions, and your lining maintained to these dimensions in spite of repeated patching, your cupola operator will be able to estimate the volume of metal tapped quite accurately, if he has the necessary experience.

Iron Shrinkage

We are casting iron blocks that must pass X-ray examination and be completely sound. We are having difficulty with internal shrinkage, inclusions, and shrinkage where the gate or riser joins the casting. What method and what size gates and risers should be used. Castings are made flat back in drag and are jolted by machine and drawn by hand. Average chemical analysis: silicon, 2.00; sulphur, 0.145; phosphorus, 0.21; manganese, 0.43; total carbon, 3.05-3.50 per cent.

Lack of sufficient data makes an inclusive analysis difficult. However, an increase in carbon content with concomitant late addition of silicon in the ladle may favorably affect your shrinkage. It is assumed that your work is not to mechanical specifications because of the low manganese and relatively high sulphur and phosphorus content.

Shrinkage where gates and risers join castings might result from choking the runner too much. It should be

enlarged, possibly to 2½ in. if you are using a ¾ in. diameter riser.

If you use top gating, the eroding action of the metal as it enters the mold may cause sand to be washed away and result in a dirty casting. A splash core in the bottom of the mold, or bottom gating, may alleviate this condition. Because of the mass of metal, allow for a sufficiently large riser, which will reduce your yield but definitely improve soundness. To safeguard against premature freezing of the riser, the use of insulating riser sleeves or exothermic riser compounds, or both, is strongly recommended. Use two risers, one on each side, bottom gate, and use a sprue midway between the risers.

Sampling Procedure

Our carbon analyses for cast steel are consistently higher than those obtained by another laboratory. We can't see anything wrong with our analytical procedure and feel that our sampling may be faulty. The test coupons, after removal from the molds, are taken directly to a drill press. We drill several locations, applying steady pressure. Chips are screened and those between 8 and 20 mesh are saved. The oversize chips and fines, including the sand and oxide coating, are discarded.

First, when you discard the under-size chips, you not only discard the undesired sand and oxide coating, but also, quite probably, some segregated portions and hard particles that often end up in the fines. Consequently, the samples obtained by selective screening are probably not representative of the casting. What you should do is remove the adhering sand and the oxide coating by grinding. Then, with these extraneous materials removed, the coupon should be drilled and all the chips obtained used for the analytical sample. Oversized chips could be broken up in a mortar.

Improper Technique

Second, the drilling technique used to obtain the chips is improper. The steady application of pressure of the drill into the blank causes the drill to overheat, resulting in partially-to-badly burned chips, identifiable by discolorations ranging from straw color to dark blue. Burned chips, although acceptable for other types of determinations, should not be used for carbon analysis, since their use almost invariably produces erratic carbon results.

For proper drilling, we recommend a maximum drill speed of 400 rpm, but preferably 250 rpm. For stainless

steel, use a straight, double-fluted drill or carbide-tipped flat drill; the drill must be sharp. Dull drills cause overheating, irregular chips, and excessive wearing of the drill which might contaminate the sample. Furthermore, the drill must not be fed continuously into the work, but should be raised and lowered repeatedly. This prevents overheating and burning of the chips, and will also produce a more uniform size of chip for the analysis. When a bar is drilled, it should be drilled on both faces, at scattered locations on the bar, and through about three-quarters of its thickness. This assures a more representative sample.

Watch Contamination

Every effort should be made to prevent contamination of the sample with oil or other carbonaceous material. Such materials will introduce extraneous carbon into the analysis and can result in a sizable error in analyzed carbon content. The drill should be free of oil, and the drillings must not be handled. Further precautions to assure the absence of oil should be



Careful drilling of the bar to prepare a good sample is the first step in obtaining accurate analytical results.

taken by washing the drillings with ether prior to beginning the analysis.

Analytical errors can be reduced by pre-igniting the alundum bedding in the combustion boats before use to destroy any adhering carbonaceous material. In addition, analytical glassware should be handled with lint-free cloths and never with the bare hand.

To give a better check on analytical techniques over a wide range of compositions, analyze several types instead of only one type of Bureau of Standards sample.

HENRY SUSS, Head
Chemistry Department
Sam Tour & Co.
New York

News of Technical Committees

Malleable Division

Research Committee: C. F. Joseph, Central Foundry Div., General Motors Corp., Saginaw, was chairman of this meeting, which was held at the University of Wisconsin, Madison.

The group was welcomed by Prof. E. L. Shorey of the University. Prof. R. W. Heine reported on progress of the research project: "Effects of Melting Furnace Atmospheres on Properties of Malleable Iron."

Following the report, it was suggested that the effect of 3, 6, 9, 12, and 15 grains per cu ft of water vapor in combustion gases be studied. The consensus was that the present work should be completed in time for presentation at the 1954 Convention.

Cast Metals Handbook Revision Subcommittee. This meeting was held on November 2 at Albion Malleable Iron Co., Albion, Mich., with F. B. Rote of that company presiding. Chapter 1 was put in final form, with certain minor revisions. It was agreed to add better photomicrographs to chapter 2, retitling one section, and add a discussion of alloys in malleable, thus eliminating chapter 6.

Chapter 3 was found to need only minor revisions, while chapters 4 and 5 will be combined to allow a more cohesive presentation of malleable properties. The chapter on pearlitic malleable will be expanded in keeping with the increasing importance of this material. Data on selective hardening and wear resistance would be included.

Chapter 8 will be revised to include latest specifications of the Association of American Railroads, and of the military establishments. Chapter 9 will de-emphasize the military applications of malleable iron in its revised form.

Brass & Bronze Division

Program and Papers Committee. This group met at Baltimore, Md. on January 9, 1954. Chairman H. C. Ahl, Down River Casting Co., first discussed the division papers then ready for preprinting. Certain mechanical problems were reviewed and the papers referred for written discussion. It was reported that the "Research in Progress" technical session will be held at the Monday afternoon meeting during the Convention. Several reports on current research will be presented and will not be preprinted or recorded.

Light Metals Division

Shell Molding Committee. A pre-meeting survey conducted by Chairman A. J. Marotta, Utica (N.Y.) Radiator Corp., placed resin evaluation first in discussion topics. It was decided that a retained strength test on shell molds at elevated

temperatures would furnish the most important data at this time. The test procedure used at Dow Chemical Co. was described and will be reviewed by Committee members at the next meeting.

After discussion, it was decided that a technical session on shell molding would be preferable in May, 1955 to a progress report. A test pattern was suggested for correlation of retained strength data with actual practice. Either "I" or "U" cylinder prints would be used. The matter will be considered further at a future date.

Chairman Marotta stated that the Committee should strive to decide what property levels are required in sand-resin mixes for light metal casting in order to advise the industry and resin manufacturers. He also pointed out the need for better correlation between tests and application.

Board Research Committee

Chairman M. A. Fladoes, Sivy Steel Casting Co., presided over a meeting held on January 25 at Chicago. Principal purpose of the session, according to a report by H. J. Heine, AFS Acting Technical Director, was to consider the production of a sound film on the fundamentals of metal solidification by the Heat Trans-

fer Committee, with the cooperation of the Steel Division.

The film would embody the results of research performed primarily at the Naval Research Laboratory, Washington, D. C. It would be in the nature of an experiment for AFS, and could be the beginning of a library of films that could be used at chapter meetings and before student groups.

Heine briefly reported comments received from members of the Heat Transfer Committee, who had reviewed a rough draft script prepared by W. S. Pellini of the Naval Research Laboratory. The majority felt that such a motion picture would have significant educational value.

Bids by three different film studios were discussed and two representative films using animation were shown to the Committee. It was suggested that the film might well include solidification characteristics of ferrous as well as non-ferrous metals, even if the running time had to be increased from 20 minutes to 30 minutes. This suggestion was favorably received by the Committee members.

Heine was then instructed to seek additional bids, based on the half-hour running time. After Board approval, the script will be rewritten by Pellini to include all major cast metals which show fundamentally different solidification characteristics.

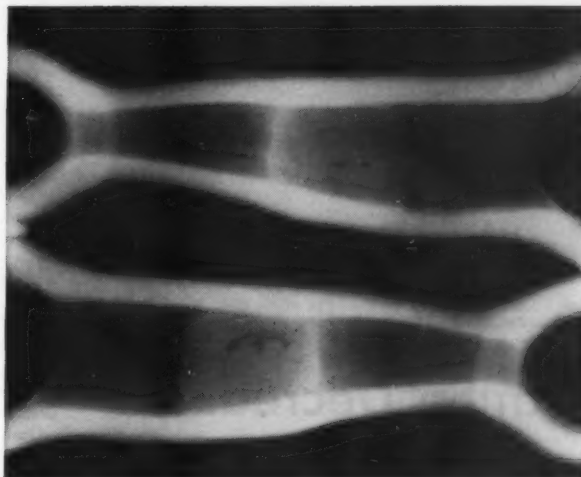
Messrs. Pellini and Heine will cooperate with the Heat Transfer and Steel Research Committees in the preparation of a small pamphlet with explanatory remarks for distribution when the film is shown. This pamphlet will aid in the presentation of the film, with or without a speaker.



Components of a 156-in. butterfly valve assembly, manufactured at the Torrance (Calif.) plant of National Supply Co., are shown being loaded on a freight car for shipment. In foreground is 26,000 lb casting of the body, sandwiched between two body flanges weighing more than 7000 lb each. Farther back on car is a 30,000 lb disc.



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It's the support for the track wheel of a tank—a tough job if there ever was one. Failure would mean complete disablement.

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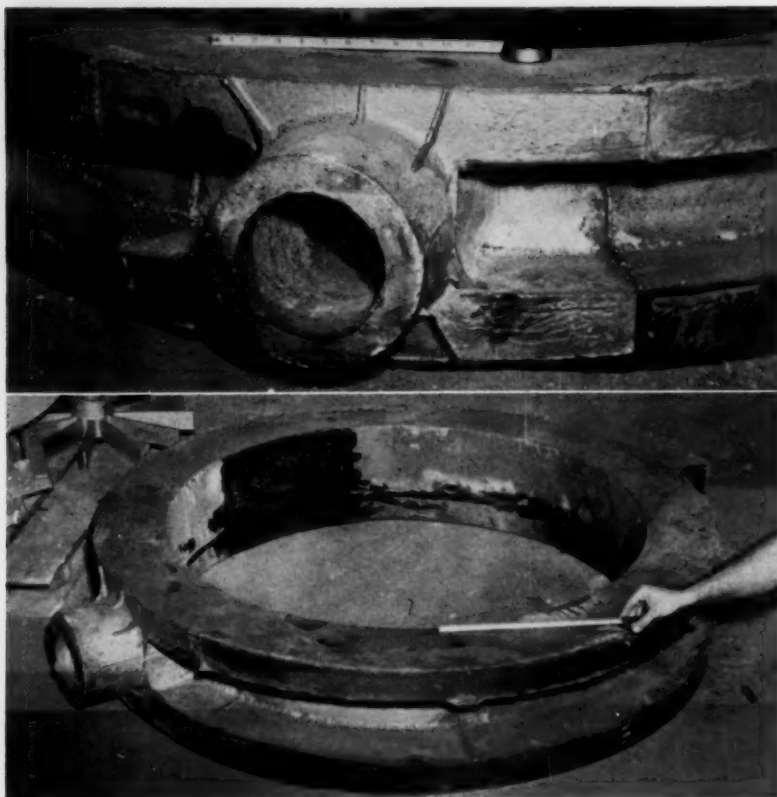
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Carbon steel flanged ring made with zircon sand cores. Net weight of casting, 4000 lb.

Metal Penetration Decreased By Use of Zircon Sands

Excerpted from the Niagara Regional Foundry Conference talk by R. J. Wilcox, technical director, Michigan Steel Casting Co., Detroit.

■ Use of special molding refractories such as zircon sand has been found to be valuable in areas particularly susceptible to metal penetration. Zircon sand is used in both green sand mixtures and core mixtures. Zircon-base mold and core wash is also used on such cores and on large molds which are made in green sand and skindried after mold washing. The zircon facing and core mixes used by Michigan Steel Casting Co. are:

	FACING	CORES
Zircon Sand	100 lb	100 lb
Cereal	1 lb	1-½ lb
Fireclay	½ lb	
Core Oil		1 pt
Moisture	3.0-3.4%	3.0-3.4%
Green Compression	3.5-4.0 psi	1.5-1.8 psi
Baked Tensile		368 psi
Baked Hardness		95 +

Typical of castings incorporating zircon sand mixtures is the one shown in the accompanying illustration. This is a

large flanged ring, the net weight of which is 4000 pounds. This casting is made in green sand, washed with zircon wash, and skin dried. The areas between the flanges and the cored hole are formed with zircon sand cores which give good cleanliness in these locations with very little erosion or metal penetration.

G. I. F. S. Hosts French Accountants

The Gray Iron Founders' Society was host to a French industrial accounting study team which visited the U. S. under the auspices of the Foreign Operations Administration to study accounting methods and literature developed by American industry and trade associations. E. Hinze, the Society's cost consultant, was principal speaker at a luncheon meeting at the Hollenden Hotel, Cleveland. Mr. Hinze outlined the Society's cost accounting activities and program and explained the use of various cost manuals used in the gray iron foundry industry. A question period followed.

East Coast Regional Program

WITH the East Coast Regional Foundry Conference scheduled for the Benjamin Franklin Hotel, Philadelphia, March 19-20, 1954, the tentative program has been released.

General theme of the Conference is: "Economic Foundry Operations," as related to all phases of the metals casting field.

Inquiries about advance registration and other information should be addressed to: J. M. Robb, Jr., Hickman, Williams & Co., Inc., 1500 Walnut St., Philadelphia, Pa.

Friday, March 19, 1954

9 am: Registration

9:45 am: Welcome and opening remarks

10:15 am: "Principles of Gating and Feeding," W. S. Pellini, Metal Processing Branch, Naval Research Laboratory, Washington, D. C.

Panel members will reply with questions or comments regarding application of the main paper to each metal: Steel: E. A. Zeeb, Dodge Steel Co., Philadelphia.

Gray Iron: John Fecko, Worthington Corp., Harrison, N. J.

Malleable: T. M. Blank, Pennsylvania Malleable Iron Corp., Lancaster, Pa.

Non-ferrous: E. J. Bush, U. S. Naval Gun Factory, Washington, D. C.

12:30 pm: Luncheon

"Quality Control in the Foundry," F. B. Rote, Albion Malleable Iron Co., Albion, Mich.

2:30 pm: Round Table Group Meetings
Subject: "Economics of Good Melting"
Aluminum and Magnesium: Discussion leader, D. L. La Velle, Central Research Laboratory, American Smelting Refining Co., South Plainfield, N. J.

Brass and Bronze: Discussion leader, H. C. Ahl, Jr., Down River Casting Co., Rockwood, Mich.

Gray Iron: Discussion leader, H. H. Kessler, Sorbo-Mat Process Engineers, St. Louis.

Malleable: Discussion leader, J. H. Lansing, Malleable Founders' Society, Cleveland.

Steel: Discussion leader, C. E. Sims, Battelle Memorial Institute, Columbus, Ohio.

Evening: Cocktail party and dinner (Details to be announced)

Saturday, March 20, 1954

10: am: "Should I Adopt Shell Molding?" T. W. Curry, Lynchburg Foundry Co., Lynchburg, Va.

Panel members will comment, representing the following fields:

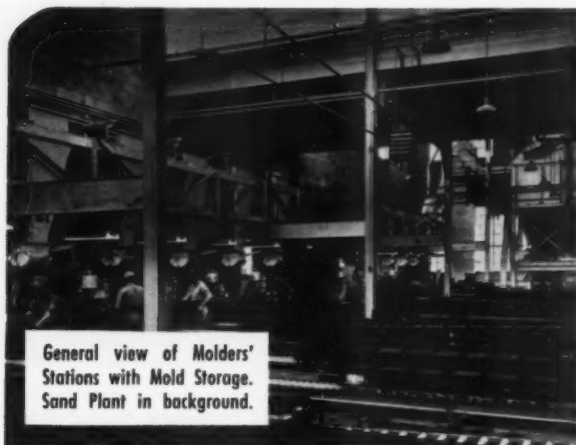
Malleable Iron: L. R. Spann, Eastern Malleable Iron Co., Naugatuck, Conn.

Pattern: E. H. Rubovitz, Newark Pattern Works, Newark, N. J.

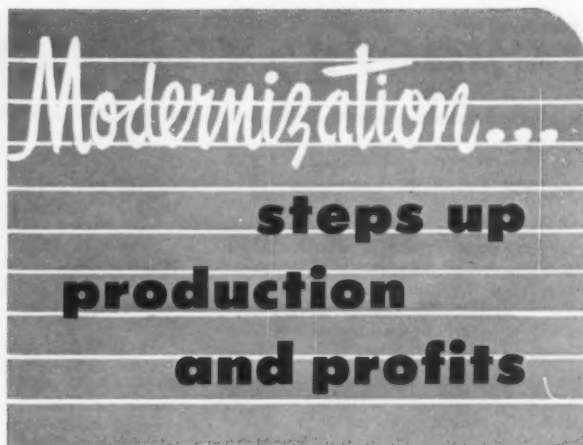
Plastics: A. Bzdula, General Electric Co., Detroit.

Non-ferrous: (to be announced)

Noon: Conference adjournment



General view of Molders' Stations with Mold Storage. Sand Plant in background.



Installation of Castings Conveyor with double-beaded flights.



Pouring and Shakeout end of Mold Storage Lines. Sand is collected on Belt Conveyor in tunnel and returned to Sand Plant.

When You Mechanize, Do it the Jeffrey Way!

Foundry mechanizations since the war have increased worker-production up to 20% according to government figures. Much of this improvement came through minimizing manual movement.

Jeffrey's engineers are constantly developing new ways to speed production and cut costs — and Jeffrey plants are producing the equipment.

Jeffrey's Modernization Service will help mechanize your sand handling, reclaiming, mixing, preparing and distributing systems; ventilating and dust-arresting equipment; mold, casting, flask, coke, pig iron, scrap and limestone-handling equipment; conveyors and reduction machinery.

Write for Catalog No. 845



THE JEFFREY MANUFACTURING CO.

Columbus 16, Ohio

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PLANTS IN CANADA, ENGLAND, SOUTH AFRICA

IF IT'S MINED, PROCESSED OR MOVED
...IT'S A JOB FOR JEFFREY!

Foundry Tradenews

Superior Foundry, Inc., Cleveland, has released a new booklet titled: "Inside Story of a Superior Casting." The publication is profusely illustrated and documents in detail operations at the company's plant.

Efco-Lindberg, Ltd., is the name of a newly formed Montreal (Can.) firm. The company will combine the resources of Lindberg Engineering Co., Chicago; Electric Furnace Co. of England; and Williams & Wilson, Ltd., of Canada. A complete line of heat treating and melting furnaces will be manufactured, including Lindberg's products.

Donegal Mfg. Corp. of Marietta, Pa. has enlarged its sales engineering service by the addition of ten men, who will serve the New England, Middle Atlantic, and part of the Midwest areas.

National Research Corp., Cambridge, Mass., has concluded negotiations for the first non-exclusive license agreement covering the NRC titanium shape casting process. The grant has been made to Titanium Casting Corp., a division of Howard Foundry Co., Chicago, which will begin commercialization of the process.

Lectromelt Casting Co., a wholly owned subsidiary of Akron Standard Mold Co., has been merged with the parent company. Hereafter it will be the Lectromelt Casting Division of the Akron company. Personnel and operations will not be affected by the change.

Investment Casting Co., formerly of 319 Chestnut St., Newark, N. J., moved to new and larger quarters on February 15: 60 Brown Ave., Springfield, N. J. New telephone number is Millburn 6-6260.

A manufacturing agreement has been concluded between Babcock & Wilcox Co., New York, and Seaboard Refractories Co., Raritan, N. J. In the future, Seaboard's entire facilities will be devoted to producing special refractories for Babcock & Wilcox.

A 90-lb magnetic rake for use in recovering metal objects from rivers and lakes was recently presented to the

Chicago police department by Robert Arnold, Arnold Engineering Co., Marengo, Ill. The rake, which will lift about 500 lb, was cast in the company's plant.

Rapids-Standard Co., Inc., of Grand Rapids, Mich., has purchased an interest in Keystone Conveyor Co., Detroit. Keystone manufactures endless chain conveyors, and Rapids-Standard produces the Rapistan equipment. New name of the firm will be Rapistan-Keystone, Inc., headquartered in Detroit.

Michigan Steel Casting Co. and its affiliates have recently undergone a top-level reorganization. Jack Bean is president and general manager of Michigan Steel; Harold W. Schroeder is the new vice-president-operations; Walter Hakin, vice-president-sales; and Elry Christensen, sales manager. Garth S. Thompson has been appointed president-general manager, Misco Fabricators, Inc., an affiliated organization. Crucible Steel Casting Co., Milwaukee, also affiliated, has George Myers as president.

Severance Tool Industries, Inc., has opened an eastern plant in Westbury, Long Island, N. Y. The firm is also adding 2000 sq ft of manufacturing floor space to its main plant at Saginaw, Mich.

A designation chart for carbon and low alloy steels has been issued by Empire Steel Castings, Inc., Reading, Pa. It identifies the company's castings with A.S.T.M., Federal, Navy, A.I.S.I., and S.A.E. specifications. In addition, the chart gives the chemical analysis, mechanical properties, heat treatment, and uses of the 18 listed steels.

Vanadium Corp. of America is concentrating its research activities in a new center at Cambridge, Ohio. Objectives include customer service, quality control, and cooperation with university research groups. First unit of the expanded center was opened on December 1, provides 30,000 sq ft of laboratories for metallurgical and chemical evaluation of metals and alloys.



First building of Vanadium Corp. research center at Cambridge, Ohio. Vanguard of an expanded facility, structure was dedicated December 1, 1953.

Mathews Conveyor Co., Ellwood City, Pa., has broken ground for an extensive expansion program. Plan involves construction of a new office and engineering building and the addition of approximately 25,000 sq ft to the present manufacturing area. All construction is to be completed within one year. The office and engineering structure will be three-story, brick, 80 x 120 ft, completely modern with acoustical ceiling, asphalt tile floors, air conditioning, and functional lighting throughout. The plan is consistent with expansion of other divisions of the company, which includes a new Pacific coast plant, and one at Port Hope, Ont., Can.

Operations of Parkersburg Rig & Reel Co. and Aetna Ball & Roller Bearing Co. will be consolidated. New firm name will be Parkersburg-Aetna Corp. A. Sidney Knowles, formerly chairman and president of Parkersburg, has been elected chairman of the board of the merged corporation. William A. Wood, Aetna president and treasurer, will hold the same offices in the new corporation. Parkersburg's plant facilities include a foundry at Pomeroy, Ohio.

The Ottawa Silica Co., Ottawa, Ill., recently honored 33 active and retired employees who have served the company for 25 or more years. Thirty-one men and two women, headed by company president G. A. Thornton, were feted at a special banquet. The men received engraved gold watches and the women diamond-studded white gold watches. Total combined service of the guests added up to more than 1000 years.

Link-Belt Co., Chicago, has established a scholarship in mechanical, metallurgical, or industrial engineering at Illinois Institute of Technology. Providing for the payment of one semester's tuition, the scholarship is intended to further foundry science and technology and to supplement the company's present education activity conducted through Foundry Educational Foundation.

Magnesium Assn. Election

During its two-day annual meeting in New York, the Magnesium Association elected its 1954 officers. The new president is J. S. Kirkpatrick, vice-president, Brooks & Perkins, Inc., Detroit. L. G. White, general manager, Dominion Magnesium, Ltd., Toronto, was chosen as vice-president. New treasurer is J. V. Cosman, president, Superior Bearing Bronze Co., Brooklyn, N. Y.

New Soil Pipe Officers

The Cast Iron Soil Pipe Institute has elected new officers for 1954 at its annual meeting.

Elected for one-year terms, beginning January 1, were: president, F. T. Hamilton, Anniston Soil Pipe Co., Rudisill Foundry Co. and Emory Pipe & Foundry Co., all of Anniston, Ala.; vice-president, P. J. Faherty, Lambertville, N. J.; and D. W. Hallman, Lansdale, Pa., treasurer.



Attending the January meeting of the Western Michigan Chapter are from left to right: F. J. DeHudy, chapter chairman; A. Demmler, acting technical chairman; Howard Wilder, guest speaker; and AFS National Director E. C. Hoenicke, dinner speaker.

Chapter News

Only Five Months Left

As of January 31, 1954, membership in the American Foundrymen's Society was 11,523. This is a gain of 131 new members for January as compared to an increase of only 26 for the preceding month but still leaves 477 new members needed to meet our goal of 12,000 by June 30, 1954. Let's get behind our membership chairmen and meet our target before June. During January two new company members have been added to the rolls. They are:

COMPANY MEMBERS

Hickory Specialty Co., Inc., Hickory, N. C.; P. G. Hendrix, Gen. Mgr. (Tennessee Chapter).
Tioga Foundry Corp., Owego, N. Y.; John E. Sweet, Jr., Pres. (Central New York Chapter) Conversion from Personal.

Texas

Seventy-four members and guests of the San Antonio Section of the Texas Chapter met January 14 to view the film "New Ford Cleveland Foundry." The meeting was held at the San Antonio Machine & Supply Co. and refreshments were sponsored by W. H. Winterborne & Sons.—Edw. W. Pruske.

St. Louis

The St. Louis Chapter played host to the Student Chapter from Missouri School of Mines and Metallurgy at the January meeting. Students and faculty climaxed a day of foundry visits in the St. Louis area by attending this meeting, which featured Harry E. Gravlin, Ford Motor Co., as guest speaker. His subject was "Sand, Metal or Men."

Mr. Gravlin placed the key to success in our industry, as with any industry, in the building of loyalty within our people by teaching them to participate to the extent that they feel a part of the industry and job it is doing. The foundry industry is a great brotherhood of men that has done a job of which it can be proud, he said.

Lloyd C. Farquhar, American Steel Foundries, extended greetings to the visiting students.—J. R. Bodine, Jr.

Northern California

James S. Campbell, Jr., Asst. Professor of Mechanical Engineering, University of California, was guest speaker at the December meeting of the Northern California Chapter at Hotel Shattuck, Berkeley, Cal. His subject was "Resin Binders." Attendance was 97.—Clayton D. Russell.



Seated at the speakers table at the January meeting of the Wisconsin Chapter from left to right: Norman Amrhein, Federal Malleable Co.; A. Gitzen, Delta Oil Products Co.; and Leonard Gratz, G. & O. Pattern Works. Photo courtesy W. Napp, Delta Oil Products Co.

Central Michigan

Preceding the January meeting of the Central Michigan Chapter, the Board of Directors visited the Battle Creek Vocational School to observe the foundry practice there. Later at the Hart Hotel meeting, Avery Allen, instructor at Battle Creek Vocational, gave the entire group a word picture of the activities of the school.

Ashley Sinnett of the Mechanical Engineering Department, Michigan State College, told the meeting about the foundry activities at Charlotte High School.

Technical Chairman Lewis C. Heisler, Gale Manufacturing Co., introduced the guest speaker, Howard Wilder, Vanadium Corp. of America. Mr. Wilder discussed cupola operations and pointed out the great advantages of a front slagging cupola. Following his talk, the Central Foundry Division film on "Shell Molding" was shown.—Bob Dodge.

Central Ohio

Members and guests of the Central Ohio Chapter met January 11 at the Seneca Hotel, Columbus, Ohio, to hear Lester B. Knight discuss the problems and advancements made in foundry modernization. Chapter Chairman, C. W. Gilchrist, introduced Fred Fuller, who in turn, introduced the speaker of the evening, Mr. Knight.

Mr. Knight defined foundry modernization as the application and successful use of methods, organization, procedure, facilities and controls that permit maximum production with a minimum number of man hours and minimum materials consumption. He included in his talk a discussion of a number of existing plant layouts.—Eldon Boner.

Twin City

Approximately 130 Twin City foundrymen welcomed Clyde A. Sanders, American Colloid Co., as the evening's speaker at the January meeting of the Chapter. Mr. Sanders' talk was entertaining and informative as he pointed out the many ways current green-sand molding techniques can be improved.

Mr. Sanders pointed out that in nearly every foundry green-sand molding practices can be so improved as to give

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Officers and directors of the Mo-Kan Chapter seated from left to right: Lloyd Canfield, vice-chairman; Wm. N. Chivvis, chairman; and H. P. Swickrath, treasurer. Standing left to right: T. F. Shadwick, director; Howard Julian, secretary; Henry Deterding, John Redman and C. W. Boeltcher, directors.

Chapter News

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greatly improved casting finish and tolerance. The foundryman's duty, he said, is to evaluate his present method—improve it—and determine if he can't get all the finish and tolerance he needs with his present method.

L. M. Malis, Crown Iron Works, chairman of the chapter's Christmas Party, reported the total attendance at the party was 340.—*R. J. Mulligan.*

Southern California

Southern California Chapter held its 17th Annual Christmas Party December 12 at the Lakewood Country Club, Long Beach, Cal. Jim Oliva was chairman of the affair which was attended by 400 foundrymen and their guests.—*Otto H. Rosentreter.*

Chesapeake

The Annual Oyster Roast of the Chesapeake Chapter was held January 9 at the Alcazar, Baltimore, Md. Three hundred and eighty-seven members and guests from Maryland, Pennsylvania and Virginia attended.

—*Henry M. Witmyer, Jr.*

Northeastern Ohio

Over 200 persons attended the January meeting of the Northeastern Ohio Chapter at the Tudor Arms Hotel, Cleveland. Coffee speaker was R. C. Hinton, Cleveland Electric Illuminating Co., who discussed the industrial development of the northeastern Ohio area. Among those present were AFS Vice-President Frank J. Dost; Secretary-Treasurer, Wm. W.

Maloney; D. J. Hayes, administrative assistant; and A. A. Hilbron, Convention and Exhibits manager. Mr. Maloney predicted that this Convention to be held in Cleveland in May will be the greatest yet and also described the progress on the new AFS headquarters building in Des Plaines, Ill. Treasurer Ray Fleig presented Mr. Maloney with a \$1,000 check as final payment of the \$3,000 pledged by the chapter toward the new building. Norm Stickney, Sand Products Co., of the membership committee, introduced 50 new members who joined the chapter during the period from September through December, 1953. With membership at 712, Vice-Chairman Dave Clark, Forest City Foundry, who presided for ailing Chairman Steve Kelly, Eberhard Mfg. Co., predicted that the chapter soon would displace Chicago as the largest AFS chapter.



Floyd Van Atta, speaking to the Foundry Safety, Hygiene and Air Pollution Institute presented at the University of Minnesota Center for Continuation Study by the College of Engineering in cooperation with the Twin City Chapter. Seated at table from speaker's right: O. Jay Myers, H. T. Widdowson and W. N. Davis.

Thomas Gallagher, executive secretary, Ohio State Foundry Legislative Association, told how his organization had been formed to help foundries in the State fight for fair legislation in the state legislature. He warned that foundries could be legislated out of business unless they were alert and organized, and he asked for the support of the industry for his group.

Technical speaker for the evening was Warner B. Bishop, Foundry Products Div., Archer-Daniels-Midland Co., who discussed the "D" molding process.

A capacity crowd of 1,000 members and guests attended the annual Christmas party of the chapter at the Rainbow Room of the Hotel Carter, Cleveland, December 10. L. P. Robinson, Archer-Daniels-Midland Co., was chairman of the affair.—*Jack C. Miske.*

Western Michigan

Approximately 120 members and guests of the Western Michigan Chapter gathered at Bill Sterns, Muskegon Heights, Mich., for the January meeting.

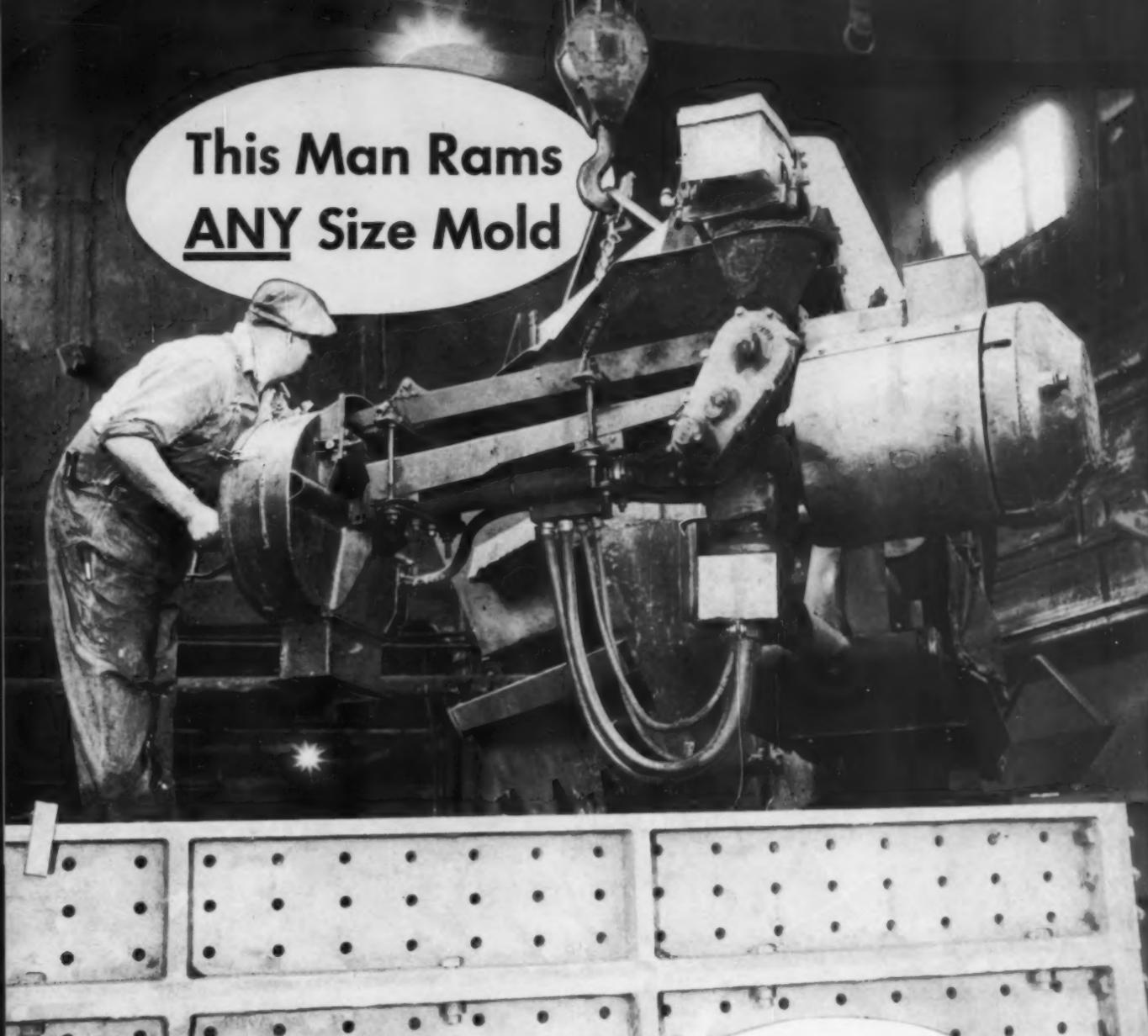
Chairman Fred J. DeHudy, Centrifugal Foundry Co., Muskegon, Mich., presided and introduced the dinner speaker, E. C. Hoenicke, Eaton Mfg. Co., National Director of AFS, who discussed the functions of the Society. A. Demmler, Campbell, Wyant and Cannon Foundry Co., acting technical chairman, introduced the speaker for the evening, Howard Wilder, Iron Foundry Div., Vanadium Corp. of America. His subject was "Cupola Operation."

—*Wilson W. Hicks.*

Central Indiana

The January meeting of the Central Indiana Chapter was attended by over 140 members and guests. Technical Chairman, Paul Faulk, Electric Steel Castings Co., introduced the speaker, Charles Schureman, sand consultant affiliated with Baroid Sales Div., National

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**This Man Rams
ANY Size Mold**

**E•LONG LIMITED OF CANADA
CHOSE A MOTIVE SANDSLINGER**

Flasks as small as 24 x 24 inches, or up to 12 x 12 feet in size, and pits up to 33 feet long are rammed by the Motive Sandslinger at E•Long Limited. Wooden or metal patterns—mounted and unmounted—are rammed with equal ease. This kind of flexibility is obtainable only with a slinger.

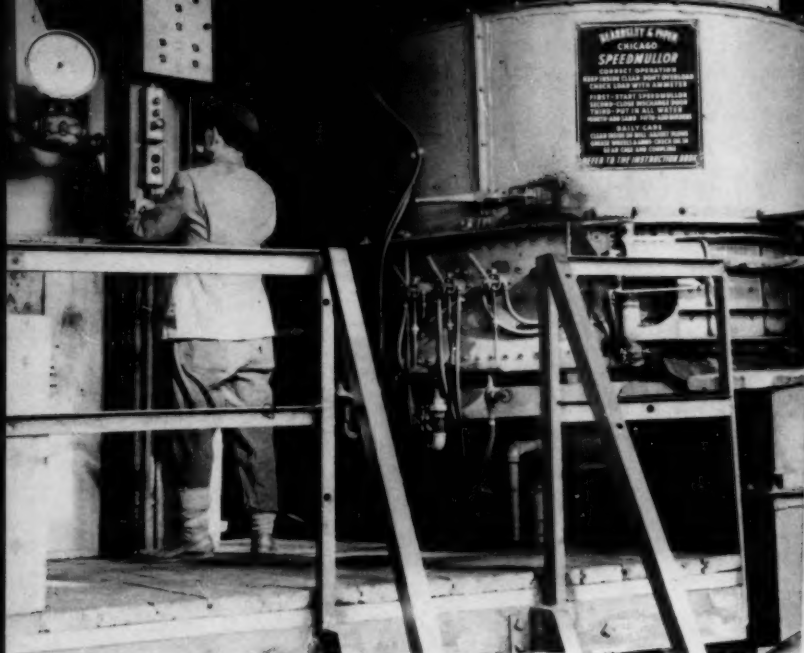
E•Long's slinger is equipped with portable sand tanks. These are loaded with mulled sand directly from a Model "60" Speedmullor, and then placed on the slinger by crane. One-hundred-twenty tons of synthetic molding sand are mulled daily, and the total Speedmullor time cycle for complete mulling and cooling is only 80 seconds.

A 12 x 12 FOOT FLASK
IS RAMMED AT E•LONG, AS A TANK
OF SPEEDMULLOR MULLED-SAND IS PLACED IN
THE SLINGER'S RECEIVING HOPPER.

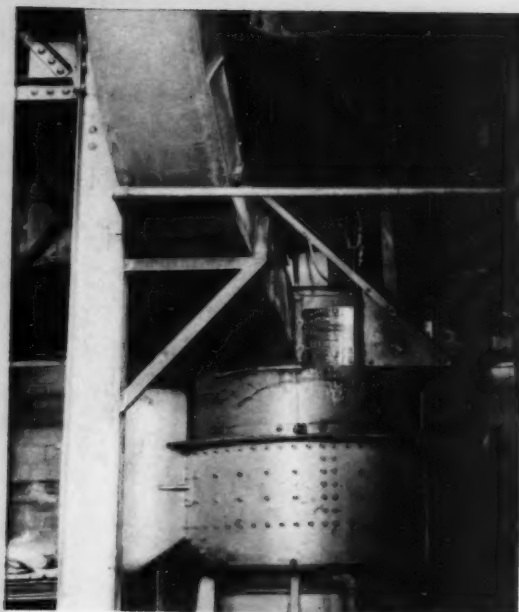
Write now for full information on
Sandslingers and Speedmullors to Beardsley &
Piper, Div. Pettibone Mulliken Corp., 2424 N.
Cicero Ave., Chicago 39, Illinois.

LOOK TO
BEARDSLEY & PIPER
FOR BETTER METHODS





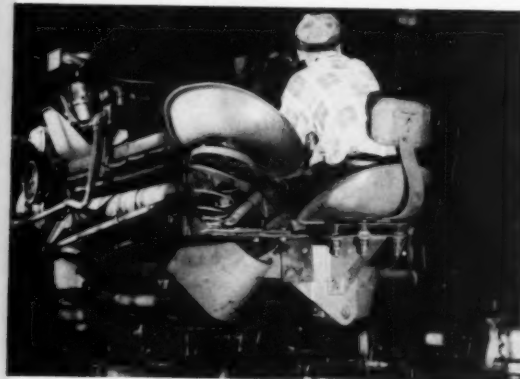
AN '80' SPEEDMULLOR mulls the foundry's molding sand. Return sand is delivered to the mullor direct from the shakeout and is very hot. Speedmullor Cooling does a real job of cooling the sand during the 1½ minute mulling cycle.



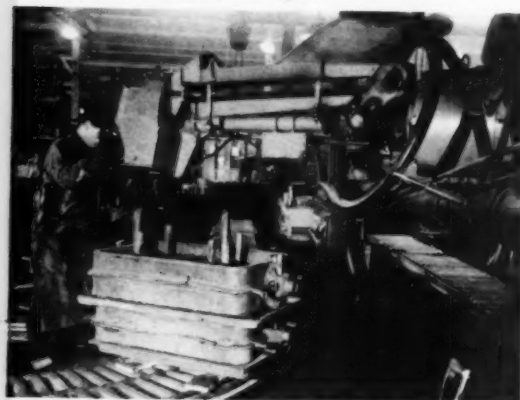
THIS '50' SPEEDMULLOR prepares the foundry's core sand and facing sand mixtures. A traveling weigh hopper above the mullor delivers the batch of sand to be mulled to the mullor. Since hot reclaimed sand is mulled this '50' is also equipped with Speedmullor Cooling.

CASTING RANGE 1 lb. to 6500 lbs. REQUIREMENTS top flexibility and economy

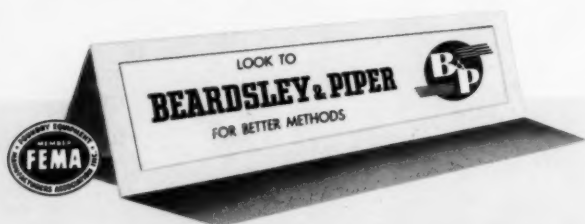
Producing steel castings of every size and type is the business of Fahrallloy Ltd. at Orillia, Ontario, and to do the job right this foundry needs equipment with top flexibility. For the class of work produced, high quality is essential and, for today's competitive market, economy is a most important factor. Fahrallloy has found from experience that Speedmullors, Sandslingers and Speedslingers meet all of their requirements. The Sandslinger and Speedslinger provide flexibility for handling a wide range of different patterns efficiently. With slinger ramming, castings are truer-to-pattern, and labor costs are held to a minimum. An '80' Speedmullor prepares all of the foundry's molding sand, while a '50' Speedmullor thoroughly mulls facing and core sand mixtures. Top capacity of fully mulled sand is assured, and with Speedmullors, maintenance costs are minimized. Your foundry can benefit, too . . . write Beardsley & Piper, Div. Pettibone Mulliken Corp., 2424 N. Cicero Ave., Chicago 39, Illinois.



ONLY A STATIONARY SPEEDSLINGER could handle Fahrallloy's large work as efficiently as it is done. A B&P Rotofeed provides a smooth stream of Speedmullor mulled sand to the Speedslinger.



A SANDSLINGER - ROLLER CONVEYOR SETUP handles many of the foundry's medium size jobs. The slinger provides flexibility for handling a wide range of different jobs without any downtime for pattern changes. It too is supplied with Speedmulled molding sand by a B&P Rotofeed.



Chapter News

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Lead Co., who spoke on "Foundry Sands." He divided his subject into four categories; choosing the proper sand, bonds, mixing, and controls. More than anything else necessary for a workable sand system, according to Mr. Schureman, is the elimination of variables. This can only be accomplished when the foundrymen become sand conscious, he said.—*Wm. H. Faust.*

Penn State

The Penn State Student Chapter meeting for December was devoted to radiography in the foundry. A talk, liberally illustrated, was presented by S. A. Crawford, Wellman Bronze and Aluminum Co., Cleveland.

Tennessee

Approximately 95 members and guests of the Tennessee Chapter attended the January meeting at the Hotel Patten, Chattanooga, Tenn., to hear R. L. Orth, American Wheelabrator and Equipment Co., speak on "Design and Operation of Blast Equipment." W. P. Delaney, Eureka Foundry Co., chapter chairman,



Panel members at Texas Chapter meeting in San Antonio are from left to right: C. R. McGrail, John Bird, Walter Temple and C. E. Silver.

presided and Chas. Chisolm, The Wheeland Co., program chairman, introduced the speaker.

Mr. Orth limited his talk to wheel blast equipment, giving thorough coverage to the fundamentals of design; selection of equipment to do the job; layout and installation, and operation and maintenance. He stressed the ultimate economies derived from employing high grade operators for blast equipment.

Paul L. Arnold, U. S. Pipe & Foundry Co., Chairman of the Southeastern Conference Committee, reported that all preparations have been made and from all indications he predicts a most successful conference. He announced that the Hon. Estes Kefauver, Senior Senator from Tennessee will be the banquet speaker.—*W. F. Hetzler.*

Rochester

H. K. Salzberg, Borden Co., Bainbridge, N. Y., discussed resin bonded cores at the January meeting of the Rochester Chapter, held at the Seneca Hotel. He related the history of making cores with resin bonds, and pointed out many of the trials and tribulations experienced by the foundries pioneering in this method of core making. The government's demand for strong, lightweight castings motivated the makers of magnesium castings to turn to resin bonded cores, he said.—*H. G. Stellwagen.*

Canton District

Canton District Chapter held its January meeting at the Canton Elk's Club, Canton, Ohio. Sixty-five members and guests were present to hear L. D. Richardson, sales manager and welding consultant, Steel Sales Div., Eutectic Welding Alloys Corp., speak on "New Advances in Foundry Welding." He described several new type welding rods and methods that can be used to weld castings of all alloys, as well as patterns and welding for foundry maintenance.

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Seated at the speakers table at the January meeting of the Chicago Chapter are from left to right: H. J. Heine, J. A. Rassenfoss and B. C. Yearley.



Attending the December meeting of the New England Foundryman's Association from left to right: J. B. Stazinski, E. C. Jeter and Henry Stenberg.



Pictured at the January Twin-City Chapter meeting are left to right: O. J. Myers, chapter chairman; Clyde A. Sanders, American Colloid Co., guest speaker; and A. W. Johnson, chapter vice-chairman.



At the speakers table prior to the January meeting of the Tennessee Chapter are left to right: Charlie Chisolm, R. L. Orth, W. P. Delaney and T. K. Wischehaue.



Jas. S. Campbell, Jr., Asst. Professor of Mechanical Engineering, University of California, guest speaker at the December meeting of the Northern California Chapter.



Members, guests and their wives dancing at the Dinner Dance held by the Western New York Chapter January 16, at Buffalo Trap and Field Club. Photo courtesy Jack Heysel, E. J. Woodison Co.



Eight Wisconsin Chapter Past Presidents attending the January meeting are front row left to right: G. K. Dreher, G. E. Tisdale, D. C. Zuege and R. C. Woodward. Back row left to right: W. W. Edens, J. G. Risney, Walter Gerlinger and H. E. Ladwig. Photo courtesy W. Napp, Delta Oil Products Co.

Chapter News

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Chapter Chairman, Robert A. Epps, Stoller Chemical Co., presided and Alfred S. Morgan, Babcock & Wilcox Co., introduced the speaker.—R. R. Kozinski.

Central New York

At the January meeting of the Central New York Chapter, 65 members and guests met in Syracuse, N. Y., for round table discussions on grey iron, non-ferrous metals and malleable iron. Don Merwin, immediate past chairman, received his past chairman's plaque and was finally allowed to enter the sacred precincts of the past chairman's club after proper investigation by Bill Dunn, Leon Hall and Curtis Fletcher.

The non-ferrous session, headed by Nate Meloon, considered insulated risers. At this session Bill Dunn gave a résumé of his trip to the World Foundry Congress.

Don Merwin directed the malleable iron discussion and furnished castings that were purposely made to emphasize certain defects.

Jim Palmer led the discussion of grey iron. Several scrap castings provided motivation for a lively treatment of such topics as whistlers, flow offs, chokes and step gates. The conclusion was drawn that step gates may need a separate sprue for each ingate to be effective—Bruce Artz.

Tri-State

The January meeting of the Tri-State Chapter held in the Blue Room of the Alvin Hotel, Tulsa, Okla., was attended by 80 members and guests. William Harris, introduced J. O. Klein, AFS National Director, who congratulated the chapter on its successful membership drive.

D. W. McArthur, program chairman, then introduced speaker of the evening W. A. Hambley, Chas. A. Krause Milling

Co., Milwaukee, whose subject was "Diagnosing a Casting Defect—Blows vs. Shrinks." His talk was primarily directed at supervision, which he described as the backbone of the shop.—Edward O'Brien.

Mo-Kan

The annual Christmas party of the Mo-Kan Chapter was held in the Ball Room of the President Hotel, Kansas City, Mo., December 4. The party included members, their wives and friends and was attended by over 300 persons.—C. W. (Joe) Boettcher.

Wisconsin

Members of the Wisconsin Chapter held their January meeting in the Crystal Ballroom of the Schroeder Hotel. R. S. Stevenson, executive vice-president, Allis-Chalmers Mfg. Co., was the guest speaker and his subject was "Where Do We Fit in the Picture?" Mr. Stevenson pointed out that manpower must be used to its fullest advantage,

which includes even better apprenticeship programs.

Detroit

Foundry Equipment and National Officers' Night was the theme of the January meeting of the Detroit Chapter held at the Detroit-Leland Hotel, Detroit. Chairman Harry E. Gravlin presided and Program Chairman was Claude B. Schneible.

National Officers present were Collins L. Carter, President, and Secretary-Treasurer Wm. W. Maloney. Harry W. Dietert and E. C. Hoenicke, National Directors, also attended.

Past National Directors attending included Frank C. Riecks, Lloyd D. Wright, Vaughan Reid and Fred J. Walls.

Speakers who were allotted a short period of time to present their organization's newest and modern equipment were: Stanley S. Davis, Royer Fdy. & Machine Co.; R. L. Orth, American Wheelabrator Co.; A. C. Eastwood, Tabor Mfg. Co.; Frank Brewster, Harry W. Dietert Co.; James Petrie, Link-Belt Co.; John M. Kane, American Air Filter; C. A. Barnett, Foundry Equipment Co.; D. R. Bair, Pangborn Corp.; A. I. Kemplin, Allis-Chalmers Mfg. Co.; Carl Sayer, W. W. Sly Mfg. Co., and Marvin Kotvis, Foundries Supply & Sales Co. Harry McMurray, Ford Motor Co., was moderator.

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Part of the group enjoying the Annual Oyster Roast of the Chesapeake Chapter in January.



Members and guests of the Central New York Chapter enjoying the floorshow at the Annual Christmas Party held December 12 in Syracuse, N. Y.

Chapter News

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Chicago Chapter

With the 213 members and guests attending, the Chicago Chapter met on February 1 at the Chicago Bar Association. President J. A. Rassenfoss, American Steel Foundries, presided over a dinner meeting that featured W. S. Pellini, superintendent, metallurgy division, Naval Research Laboratory, Washington, D.C., as technical speaker.

A high-light of the evening was the announcement of the Robert E. Kennedy Scholarship, honoring the AFS Secretary Emeritus, long associated with the foundry industry. Available annually, the scholarship will provide tuition and fees to the student who will be selected on the basis of character, ability, interest in work related to the foundry, and finan-

cial need. An initial endowment of \$5000 has been made by the Chicago Chapter.

Commemorating the event, a large bronze plaque bearing the likeness of Kennedy was prepared under the supervision of Roy W. Schroeder, of the University's Navy Pier Branch, Chicago. It was presented to Mr. Kennedy at the meeting by Dean F. W. Trezise of the University.

The meeting was also national officer's night and the Chapter honored its own past president and current AFS National Director, C. V. Nass, Beardsley & Piper Div., Pettibone Mulliken Corp., Chicago. Mr. Nass reviewed the accomplishments of the Chapter, particularly the educational work. He announced that 787 members had been signed up, out of the goal of 816. The status of the new national headquarters building at Des Plaines, Ill., was outlined. He concluded with reference to the 1954 Convention at Cleveland, described the auditorium facilities, and urged members planning to attend to send in their housing applications immediately to the Cleveland Housing Bureau.

Chapter vice-president R. L. Doelman, Miller and Co., served as technical chairman for the meeting and introduced Mr. Pellini, whose subject was, "Feeding Range of Risers."

Pellini spoke on research which has been done to evaluate the size and feeding range of risers. Feeding range, he said, is disappointingly small, pointing out the difficulty that even an adequate riser has in supplying metal through the tortuous channels that exist in a solidifying casting. He prefaced his remarks with a compliment to AFS for its dissemination of technical information.

A riser, Pellini said, must have the proper diameter to stay open for feeding, and the proper volume to provide metal to meet casting shrinkage needs. He recommended a riser height of about $1\frac{1}{2}$ times the diameter. Diameter should be a minimum 1.1, 1.6, and 2.5 times the casting thickness for cubes, bars, and plates, respectively. He was reporting work on simple geometric shapes, he said, and was referring to open-top risers insulated by any non-exothermic material.

For plates 2 in. and thicker, the effect of an end is to give soundness $4\frac{1}{2}$ times the thickness from the end. An adequate riser would feed 2 times. For bars, end effect is $6\sqrt{T}$, riser effect $1\frac{1}{2}T$. Chills at a casting end are not very effective, Pellini declared, advising using them between risers to create an end effect that markedly increases feeding range. Don't nullify the end effect by risering a casting at both ends when a riser in the center is adequate, he warned.

Strong directional solidification should be built into the casting, if possible; chills should be used in place of costly padding, Pellini said. Chill thickness should be about same as casting thickness for plates, about $\frac{3}{4}$ of the thickness of bars. In heavier castings, temperature does not influence feeding distance. Work so far indicates that knock-off risers are as effective as full-contact risers for top risering.

Other Organizations

New England

E. C. Jeters, plant manager of the Cleveland Ford Foundry, Cleveland, was guest speaker at the December meeting of the New England Foundryman's Association. He talked on modern techniques for the foundry of tomorrow. His talk was followed by a film and slides which showed the job mechanization has done for foundries. Tribute was paid to Harry Impy, a salesman since 1909, who retired January 1, 1954.—Alexander Beck.

Reading

Chester V. Nass, AFS National Director and vice-president and general manager of Beardsley and Piper, Chicago, was the guest speaker at the January meeting of the Reading Foundrymen's Association. His subject was "Mechanization in Coremaking." Technical chairman for the meeting was Hermann P. Good, Textile Machine Works, Wyomissing, Pa.—William I. Cassidy.



Harry E. Gravlin, production manager, Dearborn Iron Foundry, Ford Motor Co., addressing a capacity crowd at the January meeting of the St. Louis Chapter.



Admiring bronze plaque commemorating the Robert E. Kennedy Scholarship are left to right: Timothy Balaban, R. W. Schroeder and Robert E. Kennedy.



H. K. Salzberg, Borden Co., Bainbridge, N. Y., guest speaker at the January meeting of the Rochester Chapter.

Obituaries

Charles J. Miller, chairman of the board of directors, Fremont Foundry Co., Fremont, Ohio, died recently. He organized the Fremont firm and became its president in 1920. He received the Gray Iron Founders' Society citation for outstanding contributions to the society and industry in 1947.

Russell O. Darbyshire, vice-president, Darbyshire Steel Co., El Paso, Tex., died recently.

D. Clyde Short, 67, president-general manager of Saturn Foundry & Machine Co., Wheeling, W. Va., died November 9.

Lewis W. Mesta, executive vice-president and director of the Mesta Machine Co., Pittsburgh, Pa., died recently.

Allen G. Pike, 50, sales representative for the Texas Electric Steel Casting Co., Houston, Tex., for the past eight years, died in Houston January 3 after an illness of two months. Prior to joining Texas Electric he was with the War Production Board and was a former advertising director of the Houston Post.

Al Hard, foundry superintendent of St. Louis Steel Casting Co., died unexpectedly January 9.

Leo B. Koenig, 62, foundry superintendent at J. I. Case Co., Racine, Wis., died suddenly January 15. He had been foundry superintendent for the firm for about the past 20 years.

Information

continued from page 18

Grinding Magnesium Alloys

Technical Bulletin 523 discusses the grinding and polishing of magnesium and its alloys. Lists grinding wheel recommendations and includes table listing typical procedures for polishing magnesium alloys. *Norton Co.*

For more data, circle No. 163, p. 18

Shell Molding Machine

Bulletin describes some of the advantages of shell molding and highlights the features of the Shalco shell molding machine. *Shalco Engineering Corp.*

For more data, circle No. 164, p. 18

Metal Melting Furnaces

Bulletin No. 800 discusses Stroman metal melting furnaces and also details furnace room accessories. *Stroman Furnace & Engineering Co., Div. of Petersen Oven Co.*

For more data, circle No. 165, p. 18

Melting Furnaces

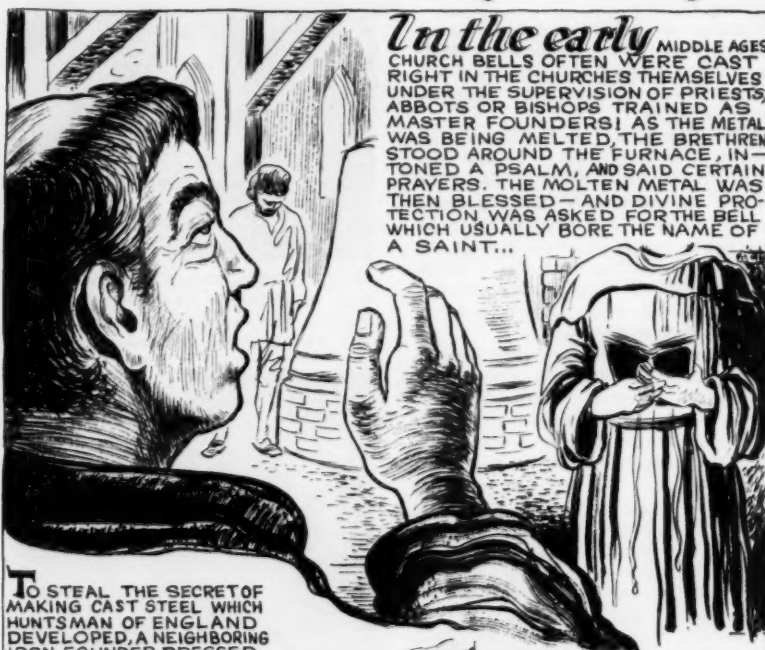
Lindberg-Fisher Simplex Melting Furnace Bulletin No. 29 contains photographs of the furnaces as well as specifications, diagrams, performance and other technical data. *Lindberg Engineering Co.*

For more data, circle No. 166, p. 18

Abrasive Snagging Wheels

Bulletin ESA-62, "Abrasive Snagging Wheels for Steel Mills and Foundries," is a 12-page catalog containing the latest grinding wheel recommendations for various materials, including titanium

CASTING through the Ages



In the early MIDDLE AGES CHURCH BELLS OFTEN WERE CAST RIGHT IN THE CHURCHES THEMSELVES UNDER THE SUPERVISION OF PRIESTS, ABBOTS OR BISHOPS TRAINED AS MASTER FOUNDERS! AS THE METAL WAS BEING MELTED, THE BRETHREN STOOD AROUND THE FURNACE, INTONED A PSALM, AND SAID CERTAIN PRAYERS. THE MOLTEN METAL WAS THEN BLESSED—AND DIVINE PROTECTION WAS ASKED FOR THE BELL WHICH USUALLY BORE THE NAME OF A SAINT...

TO STEAL THE SECRET OF MAKING CAST STEEL WHICH HUNTSMAN OF ENGLAND DEVELOPED, A NEIGHBORING IRON FOUNDRY DRESSED UP AS A TRAMP ONE COLD NIGHT IN THE 1780'S, SOUGHT OUT THE FOUNDRY, AND PREVAILED UPON HUNTSMAN'S WORKMEN TO GIVE HIM SHELTER IN THE PLANT. WHILE FEIGNING SLEEP, HE NOTED EVERY DETAIL OF THE PROCESS. HUNTSMAN HAD TAKEN SUCH PAINS TO KEEP SECRET FROM HIS COMPETITORS....

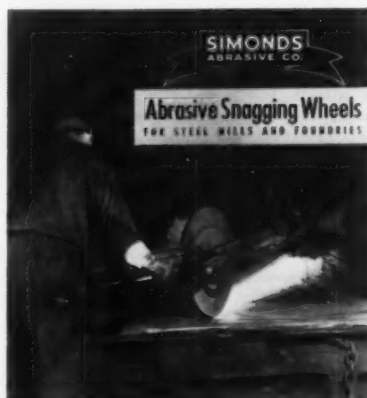


UNTIL THE MID-1800'S NO UNIFORM SYSTEM WAS USED TO DESIGN CAST IRON METAL TOOTHED WHEELS. EACH MANUFACTURER DESIGNED HIS OWN WHEELS IN ACCORDANCE WITH HIS OWN PET THEORIES. THESE WHEELS WERE USUALLY TEAMED UP WITH WOODEN TOOTHED WHEELS WHICH EVENTUALLY WORE DOWN—AND FINALLY MESHED—AFTER A LOT OF CLASH AND BACKLASH.



The Odd Bits

THE COUNTERFEITERS OF ANCIENT ROME FORGED THE IMPERIAL CURRENCY BY TAKING IMPRESSIONS OF GENUINE COINS IN CLAY AND USING THESE IMPRESSIONS TO MOLD THEIR BASE TOKENS. TO SAVE TIME AND LABOR, THESE ENTERPRISING CROOKS MADE A WHOLE SERIES OF THESE MOLDS, IMBEDDED THEM IN LOAM TO KEEP THEM FROM SHIFTING, AND TOOK OFF MANY IMPRESSIONS AT ONE TIME.



alloy. Brochure also contains data about patented Red Streak Flanges built into the grinding wheel to provide a steel against steel fit with the mounting flanges. *Simonds Abrasive Co.*

For more data, circle No. 167, p. 18

Material Handling

Booklet No. 3 points out the proper relationship between material handling and other functions in an industrial organization. General rules for analyzing work-volume and work-density are also presented with an example in chart form of work-volume analysis. *Material Handling Institute, Inc.*

For more data, circle No. 168, p. 18

Brinell Hardness

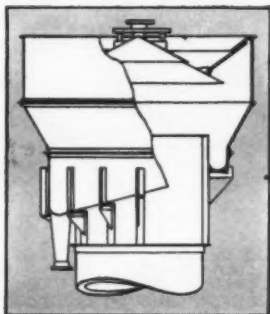
Bulletin B 953 of Brinell Hardness Testing Machines includes illustrations and complete specifications on more than half a dozen different types of Brinell Hardness Testers, plus miscellaneous accessories. *City Testing Machines, Inc.*

For more data, circle No. 169, p. 18

Payload

Bulletin 254 describes the Model HA, 12 cu ft capacity Hough Payloader. Wide variety of material handling jobs are illustrated in the booklet. *Frank G. Hough Co.*

For more data, circle No. 170, p. 18



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Heat Flow in Metal Melts and Liquid-Solid Boundary

Increasing interest of foundrymen in heat flow and solidification phenomena prompted Prof. B. Floyd Brown, North Carolina State College, to abstract and comment on "Heat Flow in Metal Melts in the Immediate Vicinity of the Liquid-Solid Phase Boundary" by Otto Schaabber. The full article appeared in Zeitschrift fuer Metallkunde, vol. 43, 1952, pp. 251-258.

■ Although many theoretical treatments of the solidification of castings, as well as rationalization of the microstructures of the finished castings, presume heat flow by conduction through the liquid and the existence of temperature gradients in the liquid metal during the process of solidification, heat flow measurements in such circumstances are lacking.

To measure this, a cubic vessel 20 cm (about 8 in.) on an edge was built, with electric heating elements in one vertical face, with provision for air-cooling the opposite face, and with the other four faces thermally insulated (except that the top could be opened). When filled with metal, this provided for parallel horizontal flow of heat from the heated face to the air-cooled face. A thermocouple sheath extended from the center of the cold face to the center of the hot, and a single thermocouple was used to measure the temperature along the horizontal centerline. The material of this sheath was chosen to have a lower conductivity than that of the metal under investigation.

Interface in Center

The vessel was filled with molten metal and the heating and cooling adjusted so that the cold end was solid but the hot end was liquid, with the liquid-solid interface approximately in the center. After precautions to obtain equilibrium, temperature measurements were taken over the length of the axis (Fig. 1). The temperature rose linearly through the solid metal, indicating equilibrium. Although the conductivity of the liquid is lower than that of the solid, the temperature curve broke not upwards, but downwards at the liquid-solid interface (which could be detected visually from above the bath), and there was no measurable temperature gradient through the liquid, although from the slope of the curve of Fig. 1 it can be calculated that somewhat more than 40,000 kilocalories per hour was flowing through it. Similar curves were obtained for pure aluminum.

The experiment was repeated with the heating element on the top surface and

the cooled face at the bottom, with results as shown in Fig. 2.

The vertical temperature distribution in the liquid was measured for the case of zinc with heat flowing horizontally (first experiment), and a maximum difference of 4 C was measured between the bottom and top surfaces. If this temperature difference and an associated convection stream were called upon to transport the 40,000+ kilocalories by pure convection, the flow, calculated by highly conservative approximations, would amount to 16.5 cm per minute. Floating particles failed to indicate any flow.

Low-Energy Crystallites

The heat flow observed was rationalized by assuming the presence in the liquid of small discrete crystalline or semi-crystalline regions (call them "crystallites") which are of lower energy content than the true liquid. These are pictured as being present in considerable quantities near the melting point but decreasing gradually to zero with increasing superheat. The flow of energy can then be envisioned in two ways:

1. If convection currents exist, the "crystallites" (being denser than the true liquid) will sink with the cooler liquid, move over to the hotter face where they will be melted (at least partly) and will rise with the heated liquid; moving over to the cooler (solid) interface they will re-form, passing their latent heat of fusion on to the massive metal.

2. A second mechanism devised to operate in the absence of convection is essentially one in which the "crystallite" from near the interface is translated toward the heated face, dissolving enroute, and leaving its heat of fusion to flow out through the solid.

Either of these calls for a large difference in heat content of the liquid at the heated face and at the solid interface although the temperature is substantially the same. A rough assessment of this difference was made by momentarily dipping identical cold rods into the two ends of the liquid region; when they were withdrawn, about twice as much zinc had solidified on the rod dipped near the solid interface as on the other, which was taken to indicate a corresponding difference in heat content of the liquid associated with a difference in concentration of "crystallites."

Mr. Schaabber's pyrometry is not of the highest precision. Little attention appears to have been given cold-junction temperature at first, for example, and effects from the blast cooling appear to extend

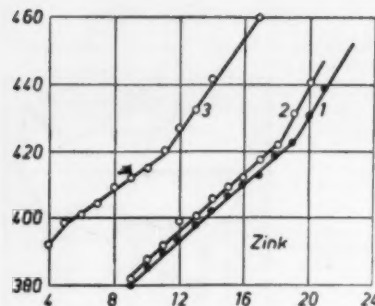


Fig. 1—Temperature distribution in horizontal heat flow experiment using zinc. Distance in centimeters from bottom is plotted as abscissa against temperature in degrees centigrade as ordinate. (Two independent runs.)

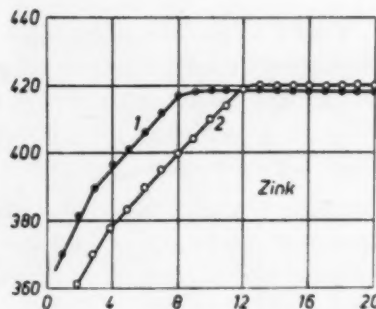


Fig. 2—Temperature distribution in vertical heat flow experiment using zinc. Distance in centimeters from bottom is plotted as abscissa against temperature in degrees centigrade as ordinate. (Three runs.)

into the thermocouple tube 3 or 4 cm (see Fig. 1). Nevertheless, the temperature breaks are much too striking to be written off as experimental artifacts.

The existence above the melting point of small ordered domains or "crystallites" (sometimes called "cybotactic groups") has been postulated in many fields in the past. These would give the liquid an enormously enhanced specific heat (presuming that their quantity diminishes rapidly with increasing superheat) because of the latent heat term, and a slow convection stream with relatively small temperature differences could therefore transport immense quantities of heat compared with the same convection stream devoid of varying crystalline content.

High Surface Tension

Although Schaabber failed to detect a temperature difference along the axis, his pyrometric standards were not good enough to rule out a small difference of the same order he found (using a different method) from top to bottom of the bath. His floating particles may have been resting on a surface held static by the characteristically high surface tension of molten metals but below which a moderate convection flow might have been occurring. Thus a slow convection mechanism

continued on page 98

SMALL CORES FOR LARGE ASSEMBLIES

PROBLEM: Small core attached to assembly for oil burner. Many of these cores loosened and dropped out.

SOLUTION: Areas where cores are joined pre-heated slightly, ribbon of Korfast applied, cores put together and again torched slightly.

RESULTS: Small cores firmly attached, drop-outs reduced to zero.

HOT CORES FOR BOILER SECTIONS

PROBLEM: Cores for boiler sections pasted while hot and allowed to stand 15 minutes. Many cores separated along the pasted joints.

SOLUTION: Korfast mixed to 95° Baume' with a Lightnin Mixer and used to paste the joint.

RESULTS: Cores no longer separated along pasted joint. A wedge and heavy hammer were used for a test and in every case sand gave way before pasted joint.

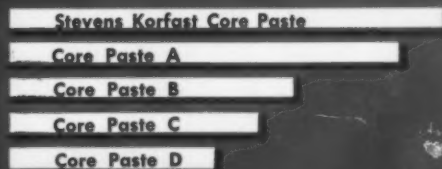
CORES FOR TRANSMISSION HOUSINGS

PROBLEM: Thirty pasted cores placed on shelves of movable core rack for wheeling to foundry. Top half of last few cores shifted due to jarring of rack. Many core blows.

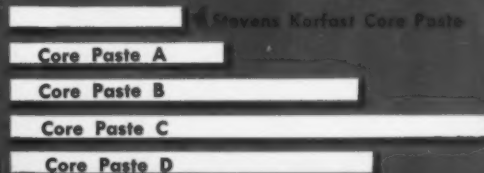
SOLUTION: Stevens Korfast mixed to creamy but viscous consistency and applied with brush.

RESULTS: Manufacturer has not experienced a single core shift. No more blows and not a single casting lost due to such shifts.

COMPARISON OF TENSILE STRENGTH



COMPARISON OF GAS EVOLUTION



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- 4 . . . sales and convention messages from leading manufacturers and suppliers.

Official record of the AFS Foundry Congress and Foundry Show will be carried in the *June Post-Convention Issue*, which will virtually bring the Convention into the homes of those who attended the Meeting for a constructive review, plus a comprehensive recap for those foundrymen who did not personally participate in the 58th Annual Foundry Congress and Foundry Show.

Like the Pre-Convention Issue the **JUNE POST-CONVENTION NUMBER**

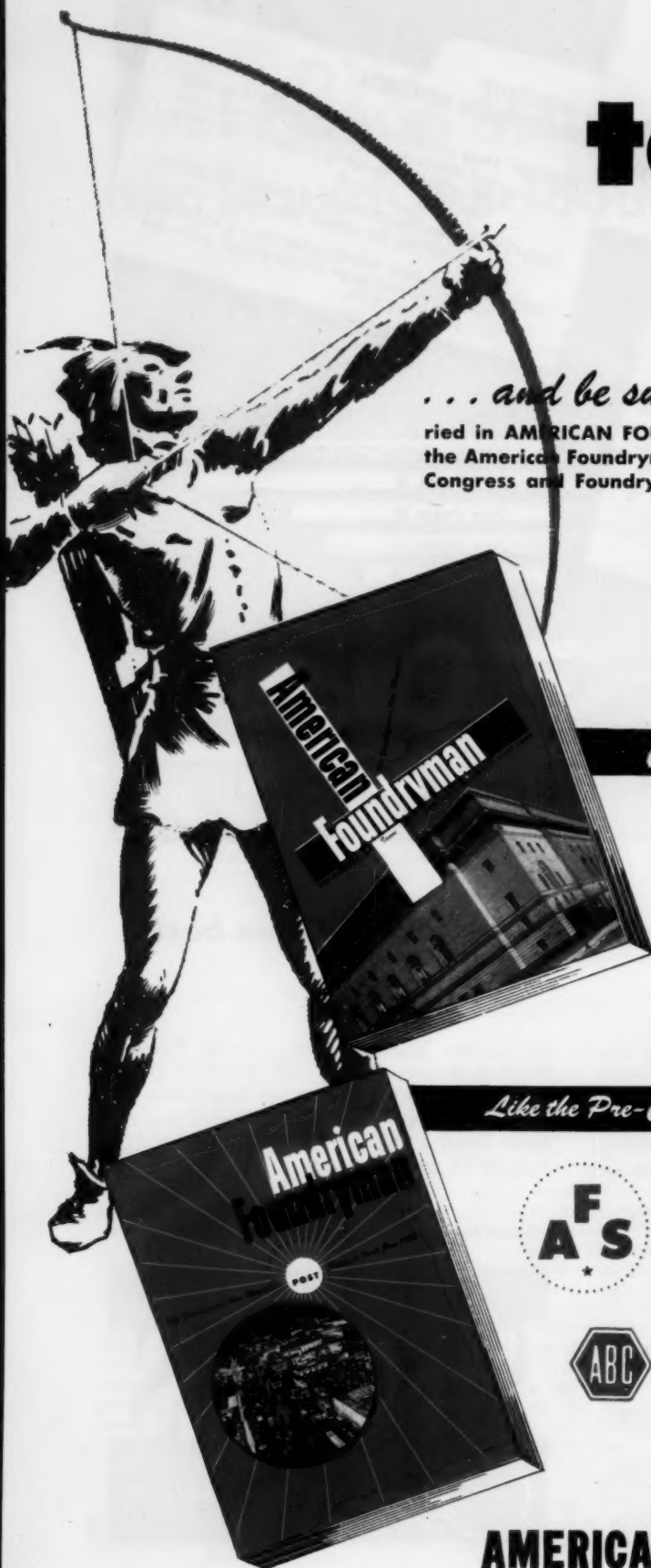
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- 3 . . . official release of the trends, policies and forecasts that keyed activities at this industry-wide get-together.
- 4 . . . messages from those companies seeking to be of service to the foundry field.

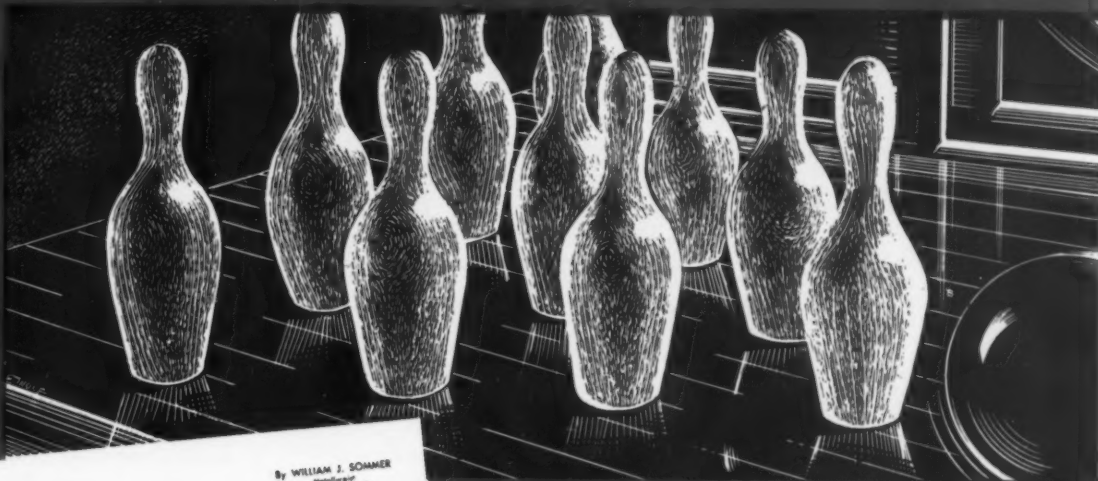
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uniformity



Quality Control:

IT'S IN THE REACH OF SMALL FOUNDRIES

Look at your inspection setup. If you're making chemical analyses, inspecting patterns, or castings, chances are you have basic elements needed to start quality control program

WITH THE foundry industry as a whole becoming more and more quality conscious and the larger companies setting up elaborate quality control programs, many smaller foundries are beginning to

ing group are all too interested in getting the work out and meeting delivery dates. If possible by-pass your standards department or have study men. Their chief concern is getting rate of production up and getting rate of production up and

reason for the scrap. The type of scrap record you keep is optional, but it should contain such pertinent data as date, customer's name, pattern number, total cost, total scrap, and breakdown of

By WILLIAM J. SCHMIDT
Manager
Plastics Co.
Hawthorne, Conn.

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March 1954 • 93



Technician measuring pH of solutions with line-operated instrument.

pH Value—

A New Foundry Term

C. A. SANDERS / Vice-President, American Colloid Co., Chicago

Practical foundrymen face a new term—pH value. This is a short story on what it is, how it is used.

■ From the tests of various foundries (private communications), it is evident that the pH of a foundry sand mixture affects most molding sand properties. Consequently, it offers another control which may be valuable in helping to further reduce the variables that are so prevalent in every foundry sand mixture. (See *FOUNDRY SAND HANDBOOK*, 6th ed., 1952, page 169.)

Foundrymen should approach pH control of sand mixtures with the knowledge that pH alone does not control sand properties. The materials in the mixture must also be considered.

Clays are complex minerals which have base exchange capacities in their colloidal portions. In addition to base exchange capacity, alkalinity, acidity, and pH curves of clays have long been under investigation. One should consider the base exchange properties of a given clay or

bonding material, but the operation is time-consuming and subject to error from contamination, and must be done by an experienced analyst. Somewhat less complex is pH, a simple number system which shows the degree of acidity or alkalinity of solutions and moist substances. It is defined as the reciprocal of the logarithm of the hydrogen ion concentration.

What Equipment is Used for pH Tests?

Two methods of determining pH are generally used—colorimetric and electrometric. Colorimetric indicators are based on the color changes of certain dyes over a defined pH range. Electrometric instruments use the solution as an unknown cell and determine the pH by relation to a known substance.

Dye-type indicators are produced by a number of chemical houses and are readily available. Two electrometric instruments are available. These employ the potentiometric method for measuring the voltage developed by a glass-calomel electrode system.

Normally, in testing a bentonite for pH value, a 6¼ per cent suspension of bentonite in distilled water is thoroughly mixed and poured directly into the cup of the electrometer and a pH determination is taken every 30 seconds until the results become constant. All readings are made at room temperature. Most accurate results have been obtained by standardizing with a buffer solution that lies within the range of the suspension. Most laboratory machines are standardized with a buffer of 9.0 pH value.

Acid and Alkali

The pH of a neutral solution at room temperature is 7, acid solutions varying from 7 to 0 and alkaline solutions from 7 to 14. The scale is logarithmic so results are not arithmetically comparable, the intensity of an alkali at pH 9.7 being double what it is at 9.4, and 100 times as strong as at 7.7. Small errors may result in wrong interpretations if pH studies are not correlated with mechanical properties.

pH of Naturally Bonded Sands

Most naturally bonded sands have low pH values. New sands taken directly from the pit range from lows of 4.0 pH to highs of no more than 7.2 pH. They are thus on the acid side. Test is performed by diluting a sample with four parts of water and checking the pH.

pH of Fireclay

Most fireclays used by the foundry industry and particularly those in the Ohio, Pennsylvania and Illinois area have a pH value of no greater than 4.7. Concentration of the suspension when testing these clay bonds influences the observed pH value. For example, a 20 per cent solid concentration may have a pH of 4.2, whereas a 40 per cent solid concentration is reduced to 3.5. Fireclays in general are on the acid side.

Testing Bentonite Gel

The initial pH value changes according to the concentration and age of dispersion. The change is slight and depends on a number of factors beyond the scope of this paper. Tests made on western bentonite gels, rather than on liquid extractions from the gels, are usually made with a machine standardized at 9.0 pH using a commercial buffer solution.

Whether the gel is used rather than the liquid extract from the gel is important. It is possible to filter a minute amount of clear solution from the bentonite gel, provided long enough time is taken and enough pressure is applied in preparing the sample. This solution has a pH much lower than the pH of the gel from which it was made.

This is the primary reason why dye-type indicators, which are popular in the general trade because they are fast, do not work well with western bentonite. The dye either is absorbed by the bentonite through a process of base exchange, or it reacts only with the water surrounding the bentonite particle and gives a false reading. Dye-type pH indicators and litmus paper should be used

continued on page 96



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pH in the Foundry

continued from page 94

on a limited scale if close pH tolerances are desired. While dye-type indicators are fast, the electric types are more accurate. Data should not be compared unless obtained by the same method of determination.

What is the pH of Bentonite?

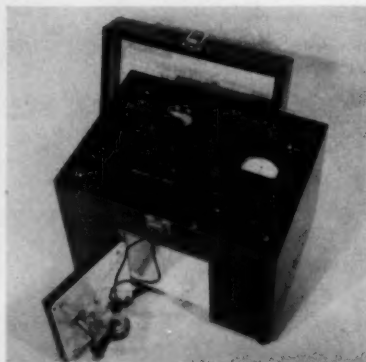
Specific bentonites have specific pH ranges. For example, the high swelling, colloidal, commercial western bentonites generally shipped from Wyoming and South Dakota have a pH range of 8.0-9.5. It has been the opinion of commercial producers that users of western foundry bentonite of high swelling characteristics would desire bentonite of 8.0, and above. In checking many thousands of samples, the average from two such commercial deposits is 9.0 pH. If such a mineral existed, pure sodium (western) bentonite would have a pH value between 11-12. Pure sodium bentonite is not known to exist in nature.

Southern bentonite, shipped chiefly from Mississippi, is classified as a calcium-type bentonite with a 6.0-7.0 pH range. It is doubtful that pure calcium bentonite, which has a 7.0 pH value, exists.

A pure hydrogen bentonite (prepared by dialysis) has a pH of 2.2, but some samples have been reported as high as 4.0.

pH Value of Foundry Mixtures

Investigating the pH in a given foundry sand mixture has merit (Bradley H. Booth, AFS TRANSACTIONS, vol. 57, p. 220 (1949)). Alert foundrymen can correlate pH with certain standard foundry tests to enable them to hold closer control on sand mixtures. The pH with other related AFS standard tests acts as a barometer, but before allowing such a



Research pH meter, one of several types useful to foundrymen. Not shown is a more rugged portable model of the same instrument.

test to be the final answer in sand control, it must be realized that materials other than, say, bentonite, are in the mixture. In most cases, particularly with steel foundry practice, most all other ingredients added are working against the pH value and bonding strength of the western bentonite. These ingredients are generally on the acid side of the pH scale.

Since most steel foundries use western bentonite as the bonding material, the effect of these ingredients must be considered. In a foundry sand mixture, there is usually a percentage of cereal, or dextrin, perhaps wood flour, organic binders and others. The cereal binder is acid and breaks down eventually into an organic acid which has a strong influence in the mixture. Wood flour may act similarly producing organic acids after being heated and aged. A gray iron foundry using a sand mixture which may contain seacoal, fuel oil, wood flour, pitch, etc., may find that the seacoal contains enough sulfur to quickly form an acid. The pitch may contain organic acids which are liberated upon heating. All of these affect the pH value.

Even the water that is used for tem-

pering may be on the acid side, particularly during the summer when chlorine is added. Distilled water which is used for test purposes may absorb enough CO₂ to acidify it, therefore, it may change the results of the pH determinations.

Wetting and Drying-out

Several years ago this author was of the opinion that the addition of certain chemical binders and electrolytes to molding sand mixtures would tend to prevent drying-out and would change the wetting action. The approach to this problem was to introduce electrolytes and other materials with temper water as the molding sand mixture was being prepared for use. Sulfur, sulphuric acid, phosphoric acid, diethylene glycol, various chlorides, dextrin, sodium hydroxide, sodium carbonate, and various cereals were studied. It had previously been claimed by certain ceramists that various chemical agents could be added to temper water to lower the vapor pressure, thus affecting the drying-out time.

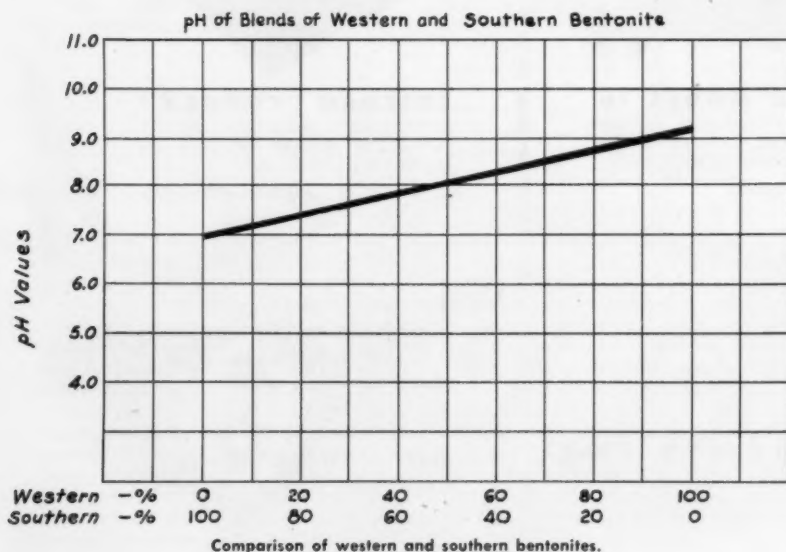
Generally, an electrolyte added to a sand mixture changes the pH value, in some cases markedly. At the end of this investigation, the question arose as to whether the change of the mechanical properties of the sand mixture was due to the change in pH value or the change in the function of the water in the mixture.

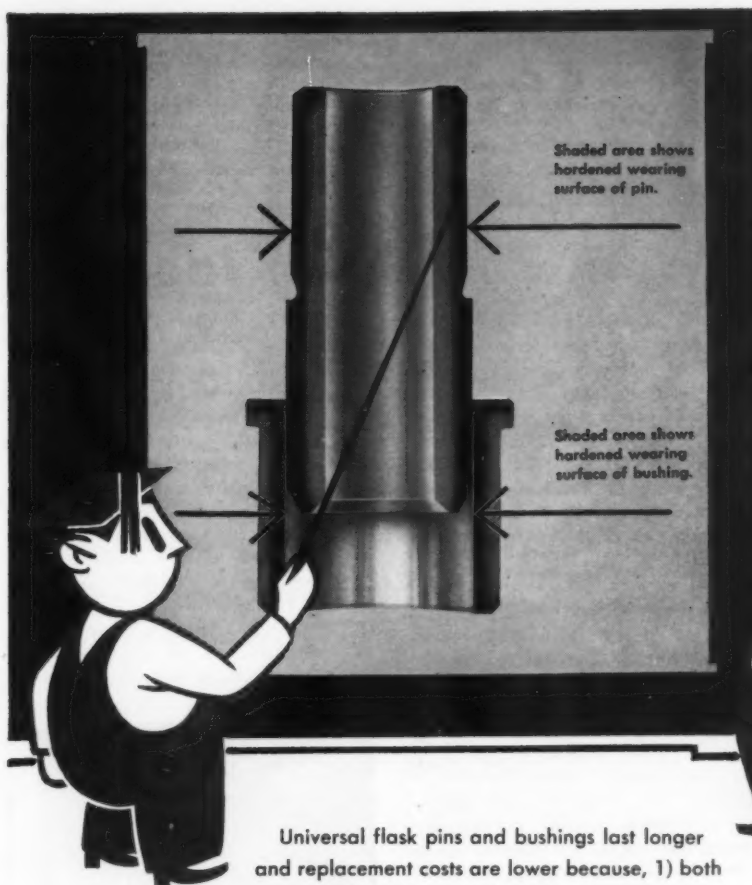
Fuel oil added to a molding sand mixture to retard drying-out, has a definite influence on the behavior of a sand mixture, particularly when western bentonite is used as the bonding agent. Ordinarily, fuel oil has little effect upon the pH value but the mechanical properties of the mixture may be greatly changed. Western bentonite bonded sand mixtures, in general, do not dry out as rapidly as those bonded with southern bentonite; in some cases, even less than fireclay bonded sand mixtures.

It was noted that electrolytes containing calcium had little effect upon the mechanical properties of the southern bentonite bonded mixtures. However, as a large percentage of lithium chloride was added to a southern bentonite bonded mixture there was an immediate drop in both green and dry compression strengths. It appeared that western bentonite bonded sand mixtures could be affected greatly by very small additions of sodium carbonate. It was found that as little as 0.1 per cent sodium carbonate added to western bentonite bonded mixtures only slightly increased the green compression strength but definitely increased dry compression strength. Greater amounts of sodium carbonate worked in the opposite direction. The sodium carbonate additions varied the pH over a wide range. Correlation of standard foundry properties with pH in this case was not close.

Fireclay bonded sand mixtures usually required a larger addition of electrolyte to show an effect. The chlorides generally caused a drop in fired strength of southern bentonite bonded sands but not so much when compared with the fireclay bonded sand mixtures. Where cereal binders were added to the mixture they

continued on page 104



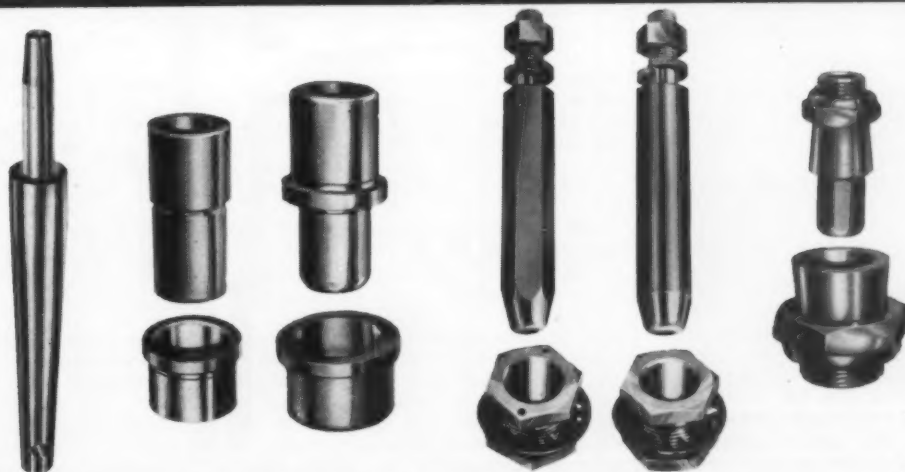


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UNIVERSAL ENGINEERING COMPANY FRANKENMUTH 12, MICHIGAN

April 1954 • 97

HEAT FLOW

continued from page 90

anism involving varying "crystallite" contents from warmer to cooler areas is a wholly credible one, despite his failure to detect either flow or axial variation in temperature.

The second mechanism, involving translation of the "crystallite" is somewhat less credible on his own evidence. It would not be necessary for the individual atoms of the "crystallite" to move, but only that the ordered arrangement move from cooler toward warmer areas, in somewhat the same way that a sound wave may move through a gas over long distances without the molecules of the gas moving more than a very small distance. There is no clear reason why this mechanism should not operate also in the case of the vertical heat flow experiment and thereby establish the same isothermal temperature distribution in the liquid as in the horizontal heat flow experiment, whereas the distribution was found to be non-isothermal (Fig. 2). The results in the vertical experiment, however, are entirely compatible with the convection mechanism.

Carl Mayer, Jr., Clarifies Location of Heating Fan

Cooperation with those companies serving the foundry field, through the pages of AMERICAN FOUNDRYMAN, prompts this correction item relating to information contained in the February advertisement of The Carl Mayer Corp. Carl Mayer, Jr., Vice President, advises that submitted material referring to a new development in vertical core ovens covered by Patent No. 2628396 included an illustration of an external heating fan (Fig. 1), whereas the new method employs a unit located inside the oven.

British Trade Journal Warns About Foundry Test Procedures

FOUNDRY TRADE JOURNAL, a British publication, reports the following extract from *Industrial Accident Prevention Bulletin* of the Royal Society for the Prevention of Accidents. The information should serve as a safety warning to all foundrymen.

"A number of castings were being tested under pressure. . . . They were 8 ft in height and 3 ft 4 in. dia., and were subjected to both water and air pressure tests. Order sheets stating the pressures to be applied to various types of castings were kept at hand for reference by the testing staff, but in this instance they were not consulted and water-pressure tests of 154 lb per sq in. and air-pressure tests of 25 lb per sq in. were carried out. Fifteen castings had been successfully tested in this way when the

sixteenth exploded under air pressure, killing one of the operators and seriously injuring another.

"The order sheets, to which reference should, of course, have been made, called for a water pressure of 38.98 lb per sq in. and an air pressure of 20 lb per sq in. for castings of this type. It is, how-

ever, fundamentally unsafe practice to carry out air pressure tests at pressures above those to which the vessels will be subjected in actual use. Tests above normal working pressure should be carried out with liquids only, as the explosive force of compressed air constitutes a serious hazard in cases of failure."

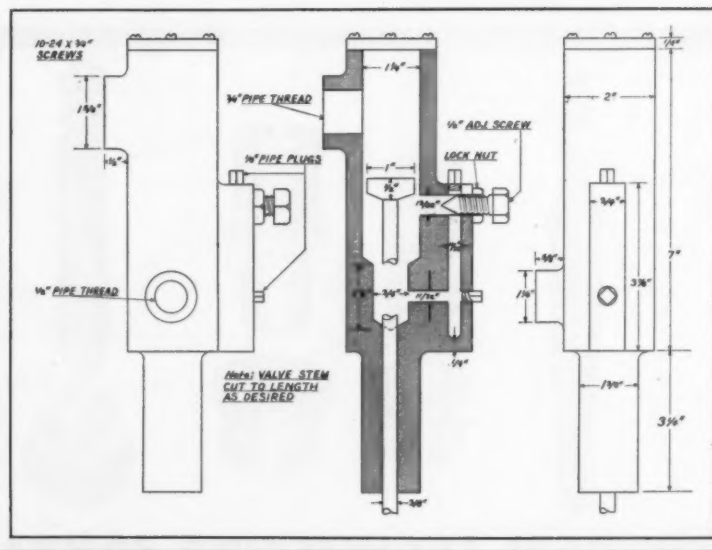
Now, There's an Idea!

Practical ideas, developed and proved in foundries and pattern shops, are presented in this column. "Now, There's an Idea!" helps American Foundryman readers promote the exchange of ideas, the motivating force behind the AFS Contributions for publication are solicited. They may be of any length, preferably short, illustrated by photo or sketch.

■ Two-speed operation of the squeeze and draw cylinder on a jolt-squeeze-pin lifting machine solved the problem of breaking numerous green sand cores in the stack molding operation at Cutler-Hammer Inc., Milwaukee. When molds are squeezed, the air cylinder travels upward 5 inches. The machine table previously dropped rapidly, tearing the green sand cores. Maintenance Man Tom Modlinski designed and constructed an air valve that allows the table to drop at the normal rate for 3 inches, during which the drag face of the mold is drawn from the pattern; then the rate of drop is sharply reduced so the cope face can be safely separated from the pattern. Slowing the drop for the full 5 inches proved unsatisfactory, according to Ed Bornfleth, foundry man-

ager, because it slowed production.

Details of the valve are shown in the sketch; the picture shows how the valve is mounted on the back of the machine with the valve stem long enough to bear on the machine table when the squeeze head is in the forward position. In squeezing, the valve stem is pushed up, unseating the valve and allowing the air to pass rapidly. As the machine table drops, the valve closes requiring the air to pass through the slow-speed channel. Critical dimension of the latter can be changed by means of the 1/2-in. adjusting screw.



AFS Chapter Schedules Foundry Safety Program

Central Indiana Chapter, AFS, is sponsoring a training course in the fundamentals of foundry safety to be presented at Butler University, Indianapolis, Ind., March 23-24, 1954. The course is primarily designed for foundry supervisory personnel. Particular attention will be given to representatives from smaller foundries, which do not ordinarily have formal safety programs. At the same time, the course is broad enough to carry strong appeals for men from larger plants.

The program will be presented under the general supervision of the Chapter's Educational Committee, comprised of: J. A. Barrett, National Malleable & Steel Castings Co., Indianapolis; Dallas Lunsford, Perfect Circle Corp., Hagerstown, Ind.; and A. A. Evans, International Harvester Co., Indianapolis.

Tuesday, March 23, 1954

- 9 am: Introduction and welcome: W. N. Davis, director, Safety, Hygiene and Air Pollution, AFS, Chicago.
- 9:15 am: Basics of Foundry Safety, W. N. Davis.
- 9:30 am: Foremen's Safety Conference Committee; Robert D. Gidel, staff representative, metals section, National Safety Council, Chicago.
- 10 am: Intermission
- 10:10 am: Foreman—The Key Man; T. A. Kraklow, Deere & Co., Moline, Ill.
- 11:15 am: Building Safety into the Plant; H. E. Fahrenbach, International Harvester Co., Indianapolis.
- Noon: Lunch
- 1 pm: Machine Guarding; Leonard Cole, Crane Co., Chicago.
- 2 pm: Foundry Safety Inspections; P. J. Munton, American Radiator & Standard Sanitary Corp., Louisville, Ky.
- 3 pm: Intermission
- 3:10 pm: Accident Records and Analysis; P. J. Munton.
- 3:30 pm: Material Handling; speaker to be announced.

Wednesday, March 24, 1954

- 9 am: Building Safety into the Working Force; Robert Beeson, Perfect Circle Corp., Hagerstown, Ind.
- 9:50 am: Intermission
- 10 am: Foundry Health Problems and Control; C. E. Dever, Mine Safety Appliance Co., Chicago.
- 11:30 am: Demonstration—How to Lift, W. N. Davis, AFS, Chicago.
- Noon: Lunch
- 1 pm: Good Housekeeping; F. G. Yelton, Delco-Remy Div., Gen. Motors Corp., Anderson, Ind.
- 2 pm: Fire Prevention; speaker to be announced.
- 2:30 pm: Maintaining Interest in Safety; J. D. Holtzapfle, Continental Foundry & Machine Co., East Chicago, Ind.
- 3:15 pm: Intermission
- 3:25 pm: Demonstration—Personal Protective Equipment; C. R. Dever, Mine Safety Appliance Co., Chicago.
- 4:30 pm: General Discussion Period—Your Own Plant Safety Problems.



A. J. Fruchtl . . . reports on committee

Steering Committee Helpful To Birmingham AFS Chapter

Hard working officers, plus a cooperative board of directors and diligent committees, are getting results in Birmingham. The suggestion that a Steering Committee be formed to outline a program of activity for the Birmingham Chapter of AFS was accepted and is now bearing fruit.

Mr. A. J. Fruchtl summarized the work of the Steering Committee which was appointed on July 6, 1953. The committee included Messrs., Charles Donoho, chief metallurgist, American Cast Iron and Pipe Company; C. P. Caldwell, president, Caldwell Foundry; T. H. Benners, Jr., president, T. H. Benners and Co.

The committee met weekly until its first draft of recommendations was ready for presentation to the Board of Directors. Four separate programs were suggested: Program 1. Publicity on "Possibilities in the Foundry." Program 2. Educational Plans on "Various Phases of Foundry Operations." Program 3. Foundry Classes stressing "Operations and Workings of a Foundry." Program 4. Scientific Studies or Investigation Programs on "Foundry Problems."

Long Range Objective

These four programs were recommended as a long range objective for the Chapter. The Directors thought so well of the plan, that they directed the committee to proceed immediately to carry out ideas relative to program #1 on publicity.

The committee contacted the Superintendent of Public Schools of Birmingham and arrangements were made for speakers to appear before each class of high school seniors.

The following speakers appeared individually before all high school groups during October and November: J. D. McGill, Jr., personnel director; B. Y. Cooper, Design Engineer; J. A. Wickett, foundry engineer, U. S. Pipe and Foundry; Aubrey H. White, chief engineer, Stockham Valves and Fittings; M. Neptune, chief metallurgist, National Cast

Iron and Pipe Co., and Frank Coupland, works manager, American Cast Iron and Pipe Co.

Each speaker emphasized the vastness of the foundry industry, with approximately 5,500 foundries employing over 500,000 people and producing over 30,000,000 tons of castings annually, worth over \$5,000,000,000. Then they emphasized that there are 105 foundries in Alabama, alone including 88 foundries in the Birmingham area.

Foundry Visits Arranged

Following these talks, principals and teachers suggested this program be extended to have the seniors visit some of the foundries. The committee agreed that "Seeing is Believing" and arrangements have been made and during January and February the seniors were guests of the foundries and saw for themselves that "the foundry is a good place to work."

As program 1 nears fulfillment, plans are getting under way to start program 2. Educational classes, with instructors being furnished by the Birmingham AFS chapter, were to get underway immediately following the Regional Conference in February. There would be at least two instructors for each class and they would have both the technical and practical knowledge to deal with the subjects at hand. The classes were limited to 25 or 30 participants.

Armour Distributes Brochure

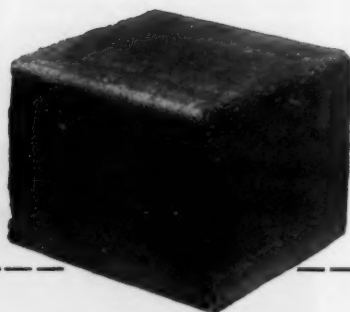
A profusely illustrated, two-color brochure has been prepared by Armour Research Foundation, Chicago. The publication describes the activities of the foundry and steelmaking sections of the research organization, noted for its experimental work for industry. Staff and facilities are outlined in the pamphlet.



John F. Smith (left), plant manager, Chevrolet Saginaw Foundry and chairman F.E.F. advisory committee at Michigan State College accepts \$2000 contribution to F.E.F. from R. D. Dodge of Archer-Daniels-Midland Co.



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Iron deoxidized with FERROCARBO® patented Briquettes is *more fluid* at casting temperatures than untreated iron. It flows more readily into thin sections or complicated molds. You get better castings...fewer misruns. Leading foundries report up to 50% reduction in misruns after using FERROCARBO in the charge.

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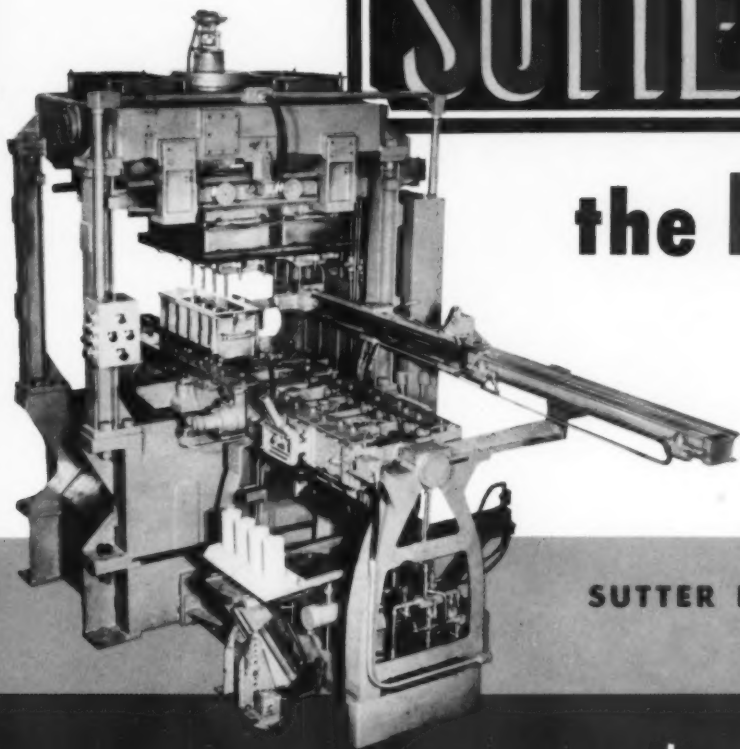
The man who uses your castings benefits, too. The castings you supply him are finer-grained, denser, stronger...much easier to machine because they contain fewer segregations and chilled or hard spots.

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Introduces **the DUAL-HEAD CORE BLOWER**

SUTTER DUAL-HEAD "MECHANICORE"

Model SP-221

PAT. PENDING

WILL BLOW TWO SIZE CORES
WITH TWO SAND MIXTURES

for Amazing Flexibility

Here is flexibility that means easy scheduling of daily production. With the Sutter Dual-Head "Mechanicore" three different schedules can be achieved. First, using both heads for the same core, production can be substantially increased. Second, full production can be maintained on two different cores—even with different sand—simultaneously. Third, since it can also be used as a single head blower, on either head, production can be switched from one core to the other with a moment's notice . . . no daily shut-down is needed for split runs. All this versatility without the cost of two complete conventional core blowers.

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Astounding output is accomplished by unique design which provides two refill stations . . . while one head is blowing the other is refilling. This not only saves time and minimizes wear, but assures adequate refill time without penalizing the operating cycle.

The entire cycle is completely automatic. Aside from pushing the start button, operators simply position dryers on blown cores and remove the drawn cores.

Automatic operation of the Sutter "Mechanicore" results in uniform, high quality cores that meet today's rigid requirements. Too, automatic operation permits unskilled operators to maintain peak production without any reduction in quality.

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PRODUCTS COMPANY • 2005 Westwood Ave., Dearborn, Michigan

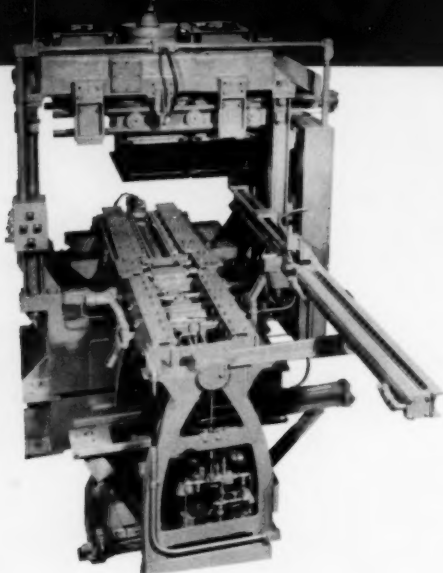
SEE MORE FACTS—Next Page

SUTTER

DUAL-HEAD "MECHANICORE"

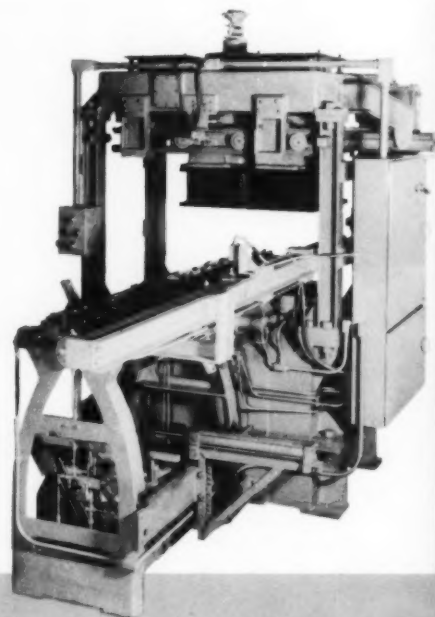
70 Years

Automatic Cycle Advanced Design



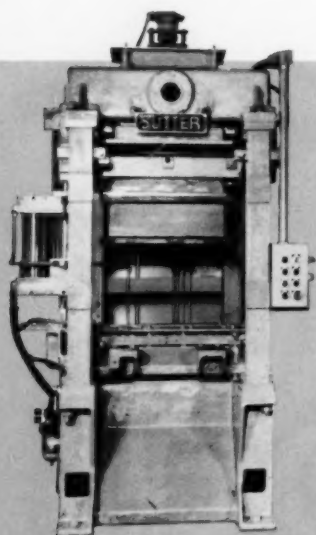
Shown here is the Sutter "Mechanicore" Model SP-221 Automatic Core Blower with double heads, the Sutter Automatic Double Rollover Core Draw Machine with push-out device and the Sutter Automatic Transfer device which moves the blown cores from the blower to the draw machine. This is only one of many set-ups possible. For example: two draw machines can be utilized, one on each side of the blower, or a "merry-go-round" (indexing arrangement) can be installed. With any of these set-ups, one core can be blown while another is being drawn.

Core boxes have been removed to show the unique design and rugged construction. Note, too, the compact location of all components.



This is another view of the same set-up. In actual operation, the head on the right side would be filling while the head on the left is blowing. Then both heads would move left, one blowing and one filling. This design with two refill stations eliminates the return shuttle stroke.

Model SP-221 maximum core box size—36" long x 15 3/4" wide x 12" deep, maximum core weight—125 lbs.



SUTTER "MECHANICORE" Model SP-220 Automatic Core Blower with one head

This core blower and all Sutter blowers are constructed of cast iron and steel with hardened and ground guides and bushings for dependable operation and long life. It embodies all the advanced design and construction advantages of the SP-221 blowers above.

An important feature is the integral air reservoir which assures an even air supply and firm sand blow at all times without extra tanks and lines.

Accurate core box and blow plate alignment is always maintained.

Maximum core box size is 36" long x 20" wide and 12" deep, maximum core weight—125 lbs.

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Film on Gases Available

A new 16 mm color motion picture with sound track, entitled "Whatever We Do," has been produced by Air Reduction Sales Co. The film is a documentary about the atmospheric gases—oxygen, nitrogen, argon, helium, and other rare gases—and covers their key uses in industry and the innumerable ways they affect our daily existence.

The story of how pure gases are separated individually from air is described with assistance of detailed animation. Some dramatic photography illustrates the role of these gases: oxygen in steel refining and in the welding and cutting of metals; neon for electric signs; argon for incandescent light bulbs; helium for aircraft; nitrogen in nylon manufacture; food packaging, and testing telephone cables.

"Whatever We Do" is not a technical film. The running time is 23 minutes. It may be borrowed from any Air Reduction district office, or by contacting Air Reduction Sales Co., 60 East 42nd St., New York 17.

Foundries Make F.E.F. Contributions

M. J. Allen, director of personnel and public relations, American Steel Foundries, has presented a \$10,000 special contribution to F.E.F. president J. T. MacKenzie. The gift supplements the regular annual contributions by the company. Half the sum was allocated to the new Endowment Fund and the remainder will be used as directed by the company for foundry educational purposes. The F.E.F. Endowment Fund now includes contributions from: Eaton Mfg. Co., Carondelet Foundry, Buckeye Foundry Co., and American Steel Foundries.

New Scholarships

In addition to its participation in the regular F.E.F. program, Link-Belt Co. has established company scholarships at Purdue, Illinois Institute of Technology, and Pennsylvania State College. The company scholarship was developed with the cooperation of the Foundation. Initial awards will be made in April for the 1954-55 school year.

Nothing Is Impossible

Foundrymen have always taken great pride in their ability to produce castings under the most adverse circumstances. (And once in a while one of them loses his shirt as a result.) Accordingly, it will be no surprise to foundrymen to read this account of a U. S. Army foundry operation in Italy. It is taken from "War Is Not All Fighting," Col. M. E. Baker, *Armed Forces Chemical Journal*, October 1953. The story tells how a chemical officer (Baker) and an ordnance officer took over a bombed Italian arsenal and made it run. Of the pattern



Portion of group that attended the institute in Foundry Safety & Hygiene, November 23-24, 1953, at University of Minnesota. Representatives of 21 foundries participated in a program sponsored jointly by the University and the Twin City Chapter of AFS. Program was arranged by the Chapter Educational Committee, consisting of: O. J. Meyers, Archer-Daniels-Midland Co.; Carter DeLaitre, Minnesota Electric Steel Castings Co.; F. E. Berger, University of Minnesota; C. F. Quest, J. F. Quest Foundry Co.; B. J. Derr, Minneapolis-Moline Co.; G. B. Milligan, Minneapolis-Moline Co.; and Fulton Holtby, University of Minnesota.



World's largest single radiograph, a giant X-ray picture of two rifles, produced by magna-scanning with 22-mev betatron has been produced by Allis-Chalmers Mfg. Co. Technique has been successful in revealing details of flaws down to 0.001 in.

shop and the non-ferrous foundry, Baker writes:

"Fortunately we found a patternmaker who could read and speak English quite well and he was most useful. Our men worked along with the Italians without friction and in a very short time the patternmakers had turned out exact models of the things we needed. They first made the model in wood, a trifle large, then made an aluminum casting from that model and machined and sculptured the aluminum into the exact form desired.

"The foundrymen had a secret mixture

composed of a special clay, coke powder, and some other stuff which they used to make the molds and their products had the most minute tool marks of the aluminum pattern. We had a great pile of broken bronze elevating bands from 4.2 mortars which went back into the melting pot along with some more tin, a bit of aluminum to deoxidize the melt, and presto, we had new elevating bands, a pound or so heavier than the American models, but much stronger and tougher. Only a little hand polishing was needed to put these bands on the weapons and get them to firing once more!"

pH VALUE

continued from page 96

appeared to reduce the rate of drying-out of both the fireclay bonded mixtures and the southern bentonite bonded mixtures, but were much less effective where western bentonite was used as the bonding agent. In fact, even though the laboratory data indicated that there was a tendency for less drying-out, the mixture felt very friable and "crumbly" when cereals were added. The pH value in each of these cases was altered significantly.

It is questioned whether the pH changes are any more than coincidental to the main factor of the wetting and drying-out action of the sand mixture. pH may be used as a tool for measuring, but several investigators have preferred to use more simple tests such as AFS deformation and flowability to measure results. They argue that pH is too dependent upon variables for accurate decisions and therefore frown on it except to get supplementary data. Sulfite binders, for example, have a hygroscopic action and make the sand mixture feel wetter, but at the same time the pH value of the sand mixture is lowered. There is less drying-out of the mixture due to the sulfite binder's affinity for water, but which is the determining factor—moisture content or pH?

The hardest and toughest air-dried skin which was found in any given mixture was sand which contained fireclay and sulfite binder. However, slightly under the surface, the mixture was soft and moist. It was thought that this might be responsible for pin holes and might give other difficulties. But pH, which was altered, could not be associated with such difficulties.

Effect of pH on Casting Results

Most investigators have not been able to correlate pH value with casting defects. To state that changing from 8.0 pH to 9.2 pH will overcome a certain defect is dangerous. A western bentonite with a pH value of 8.0 and one with a pH of 9.2 may make little difference in the mechanical properties of the mixture. However, if the lower pH of 8.0 were raised to 9.2 by the addition of an electrolyte such as sodium carbonate, then differences in deformation, temper water, feel, etc., result. Molding characteristics are altered by the electrolyte addition.

Effect of pH on Sand Properties

Many steel foundries seek certain bonding materials for one property, but they expect another. For example, many bonding materials purchased by the foundry specify that the green compression strength must be as high as possible. Very little is said about the deformation. However, deformation tests, even though erratic at times, are more satisfactory in judging a sand mixture than green compression strength if only a single test is the basis for judgment.

Experience proves that molders never complain of a mixture that has a high

green deformation strength. The molder may claim the sand is slippery, tough, etc. He generally bases this upon his ability to feel. Brittle and friable sands are labeled "improper for use." The brittle sands, however, may contain the highest green compression strength, but the molder desires deformation and toughness. Usually, the higher the moisture content of the western bentonite received by the foundry, the higher the deformation.

By adding minute amounts of sodium carbonate, or other alkaline materials, the deformation of the sand mixture can be altered rather rapidly and at the same time the temper water feels wet. This is what the molder is after and he will praise this type of sand mixture. The pH is immediately increased if an alkali is used but that does not ordinarily mean the increase in pH has resulted in better castings but better feel for the molder.

Most fireclay bonded sands do not possess high deformation, and it can only be acquired by large additions of corn flour or western bentonite. Fireclay mixtures are on the acid side unless various electrolytes are added to bring the pH value to a higher level and thus give the molder the desired feel. Possibly, soap or other detergents could be added to such a mixture which might please the molder as it relieves the brittleness. This may not make for better castings, but certainly better molding feel.

The foundry does not get paid for the molds, but for the castings, therefore, plants should give this strong consideration. If more and better molds are thus produced because of feel, then it is an answer for such casting defects.

Western Bentonite vs. Southern Bentonite

The graph shows that any pH can be obtained by mixing southern and western bentonite due to their normal pH differences. The foundryman may blend these two to obtain any pH desired. Thus, users should not assume that pH is the most important factor.

If every foundry were to use an alkaline mixture, then each would perhaps be using western bentonite but would never use naturally bonded sands, southern bentonite or fireclay mixtures. As stated previously, the average fireclay by itself has a pH of less than 4.5 which would definitely condemn it for any use by these specifications. Naturally bonded sands with a low pH of probably less than 5.0 would never be used, particularly in gray iron and malleable foundries. That such isn't the case indicates that pH isn't the sole factor in judgment.

Foundrymen should check the changes that occur in all properties. The term pH value should be handled with care; all should be warned against assuming that only this test is the one that is important without considering the others.

It is the writer's opinion that pH value

measurement in the foundry will result in determining the feel of the mixture and for that reason endorses its use. It should, however, be associated with mechanical properties such as green compression strength, deformation, dry compression strength, hot properties and the others. To satisfy molders, its use is encouraged along with the use of electrolytes to get better molding results.

It is a good test to use in formulating specifications, along with moisture content and grind. The limits should be fair to both user and supplier. It is fair for western bentonite to range from 8.0-9.5, southern bentonite from 6.0-7.0, fireclay from 3.5-4.5, and naturally bonded sands, 4.0-7.2. Foundry mixtures now vary from 3.0 to approximately 9.9.

Safety & Air Pollution in News

Here are some of the returns on money invested in air pollution equipment for the foundry.

It helps to keep the roof clean, elimination time and labor on this job.

Eliminates labor to free clogged roof downspouts.

Reduces frequency of oiling and painting of sills, cranes, machinery; protects from acidic dust corrosion.

Eliminates special handling of fly ash sweepings from the roof.

Improves general plant cleanliness and housekeeping.

Eliminates liability for cleaning neighbors' roofs.

Generally improves public relations, a valuable factor that is difficult to measure in dollars and cents.

Foundrymen who are installing air pollution equipment should know about bill number HR 2720, introduced into the House of Representatives in February. The bill gives tax benefits by the rapid amortization of equipment used for the collection of atmospheric waste.

Foundry Accident Rate Improves

The accident frequency rate for the second quarter of 1953 has just been released by the U.S. Labor Department. The rate for the overall foundry industry has improved. For this period, gray iron and malleable foundries have a frequency rating of 30.8, compared with 33.8 the previous year. Steel foundries are rated at 21.0, dropping from 26.4. Non-ferrous foundries have a rating of 22.8, compared with 1.2. These frequency rates are based on number of accidents per million man-hours worked. Steel foundries led the industry with a reduction of 5.4.

New British Publication

The Institution of Mechanical Engineers, London, Eng., has begun publication of a new magazine. The Chartered Mechanical Engineer. Largely concerned with the affairs of the Institution, the publication contains much information of value concerning British industrial engineering practice.



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Over the centuries, man has found fire clay an ideal medium to express his artistic faculty. Illustrated here is an example of ancient fire clay use . . . a painted jar* found in graves belonging to New Stone Age People who lived in northwest China more than 3,500 years ago.

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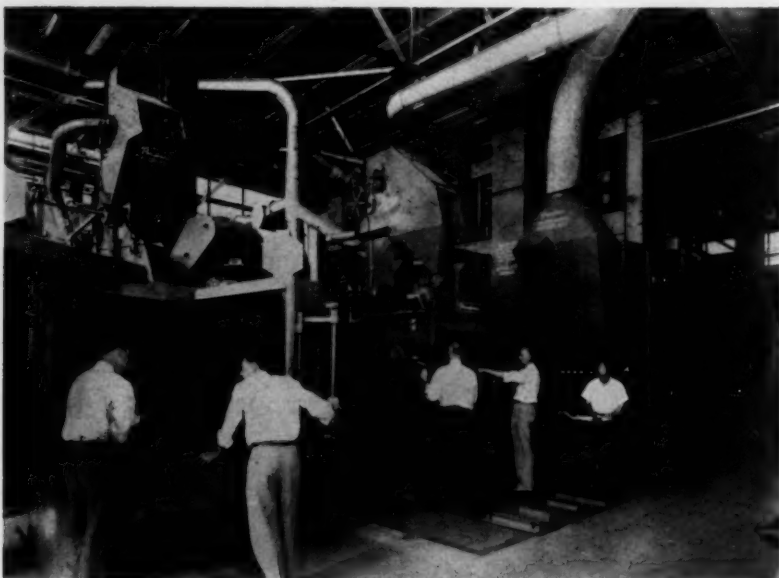
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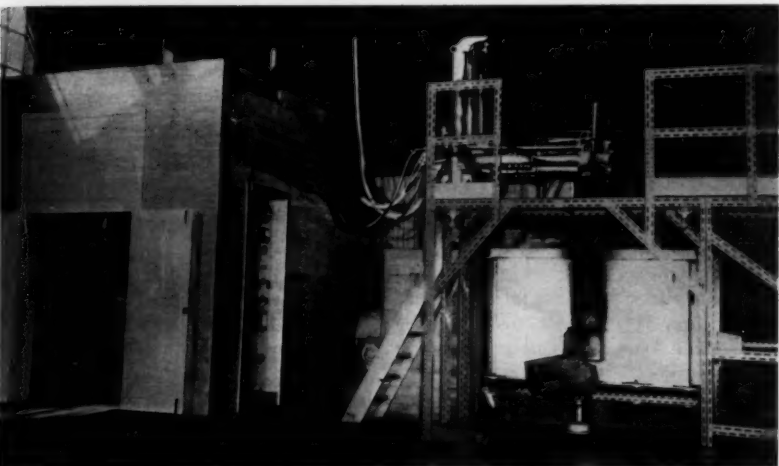
* Courtesy Chicago Natural History Museum



Several additions have been made to the demonstration room of Pangborn Corp. at Hagerstown, Md. The room was designed to solve blast cleaning and dust control problems through the operation of full-size equipment of all types. Here customers are being shown results by members of Pangborn staff.



Magnesium castings must operate under the most severe conditions in jet-engine service and no porosity can be tolerated. York Gears, Ltd., Toronto, Ont., Can., is using Stokes vacuum impregnating equipment to correct porosity. Castings are handled in rack shown (left), which is suspended from an overhead track. At left is open impregnating tank and impregnant storage reservoir. Detergent cleaning tank and rinse tank are directly beneath rack, curing oven is at right. Photo at right shows gearbox housings (circled), installed on jet engine.



A new 200 kva arc furnace has been installed in an Ottawa laboratory of the Division of Mineral Dressing and Process Metallurgy of the Department of Mines and Technical Surveys in Canada. The Lecomelt furnace is being used in the production of ferroalloy-type materials.

F.E.F. Lists Graduate Engineers

Foundry Educational Foundation has published a listing of February engineering school graduates, including those holding F.E.F. scholarships, and others who have elected courses primarily based on foundry technology and practice. The pamphlet includes data concerning graduates' address, military experience, work experience, draft status, scholastic and extra-curricular activity, and type of position sought.

Address F.E.F. at Terminal Tower Building, Cleveland 13, Ohio, for a copy of the publication.

M.F.S. Contest Winners Announced

Malleable Founders' Society has released names of winners in its safety letter contest, open to employees of member plants.

First prize winner was Lawrence Kelin, National Malleable & Steel Castings Co., Indianapolis, who was presented a check for \$100 at the Society's annual meeting in Cleveland on January 22.

Second prize, \$75, went to Leonard Bortosz, National Malleable & Steel Castings Co., Cicero, Ill.; third prize, \$50, to W. B. Sobers, Chain Belt Co., Milwaukee; and fourth prize, \$25, to James Weigand, Marion Malleable Iron Works, Marion, Ind.

N.F.F.S. Appoints Meeting Committee

Robert Lansenkamp, president, Non-Ferrous Founders' Society, has named Dan Wellman as chairman of the Annual Meeting Committee. Culminating in the annual dinner meeting on May 10, 1954, the Society will hold a board meeting on May 8, and a membership meeting on May 9, all in Cleveland.

Other appointments were also made by President Lansenkamp. New trustees to F.E.F. are: T. B. Belfield and E. J. Metzger. New alternate directors are: District 3, Elmer Brumund; District 19, C. H. Attwood; District 5, D. T. Wellman; District 10, William Stone; and District 1, A. B. Messmer.

A.S.T.M. Corrosion Committee Expands Specimen Facilities

The A.S.T.M. Advisory Committee on Corrosion, at a meeting recently held at the site of the International Nickel Co. Harbor Island Test Station, Wrightsville, Beach, N. C., took action to expand its test site facilities. Recognizing the tremendous economic loss from corrosion each year, the Society has moved to provide 110 additional racks, 60 of monel for marine exposure, and 50 of type 302 stainless steel. These racks will provide space for 7700 additional 4 x 6-in. specimens.



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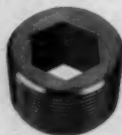
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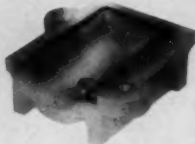
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Chapter Meetings

March

1 . . Central Indiana

Antheneum, Indianapolis. K. F. Lange, Link-Belt Co., "Foundry Mechanization."

1 . . Western Michigan

Grand Rapids. W. B. George, R. Lavin & Sons, Inc., Chicago, "Metallurgy in Brass Foundry."

1 . . Central Illinois

American Legion Hall, Peoria, Ill. C. V. Nass, Beardsley & Piper Div., Pettibone Mulliken Corp., "Mechanization of Core Making."

1 . . Metropolitan

Essex House, Newark, N. J. Round Table Meeting. Robert A. Colton, American Smelting & Refining Co., Non-Ferrous; A. J. Derrick, American Brake Shoe Co., Iron; and Harlie M. Freeman, Taylor-Wharton Iron & Steel Co., Steel.

1 . . Chicago

Chicago Bar Association, Chicago. "Recent Developments in Molding Processes," Tom Barlow, Eastern Clay Products Co., "High Pressure Molding," and Harry W. Dietert, Harry W. Dietert Co., "D Process."

2 . . Rochester

Seneca Hotel, Rochester, N. Y. H. L. Smith, Federated Metals Division, "Brass and Bronze Foundry Practice, Especially Melting Techniques."

4 . . Canton District

Alliance Elks Club, Alliance, Ohio. National Officers Night. Collins L. Carter, AFS National President.

5 . . Western New York

Sheraton Hotel, Buffalo, N. Y. Clyde A. Sanders, American Colloid Co., Chicago, "The Use and Mis-use of Green Sand Mixtures."

8 . . Cincinnati

Suttmiller's Restaurant, Dayton, Ohio. Thomas F. Kiley, Meehanite Metal Corp., New Rochelle, N. Y., "Meehanite Metal."

8 . . Michiana

Split Meeting. Harold L. Kline, Studebaker Corp., South Bend, Ind. "Time Study and Standard," and J. G. Kura, Battelle Memorial Institute, Columbus, Ohio, "Effect of Gating Practice."

9 . . Twin City

Covered Wagon, Minneapolis, Minn. Howard H. Wilder, Vanadium Corp. of America, "Cupola Operation."

11 . . Northeastern Ohio

Tudor Arms Hotel, Cleveland. National Directors Night. Robert Zollar, Zollar Casting Co., Bettsville, Ohio, "New Era in Cupola Melting."

12 . . Southern California

Rodger Young Auditorium, Los Angeles. Ray Sutter, Sutter Products Co., Dearborn, Mich., "Shell Molding."

12 . . Texas

Fort Worth, Texas, John Kane, American Air Filter Co.

12 . . Tri-State

Bartlesville, Okla. Ray Cochran, R. Lavin & Sons, Chicago.

12 . . Wisconsin

Hotel Schroeder, Milwaukee. General.

Chapter Meetings

16 . . Saginaw Valley

Fischer's Hotel, Frankenmuth, Mich. Joint Meeting with A.S.M. H. W. Dietert, H. W. Dietert Co., "The D Process Molding."

17 . . Central Michigan

Hart Hotel, Battle Creek, Mich. R. T. Lewis, Keen Foundry, "Are Your Costs Reliable?"

17 . . Oregon

Heathman Hotel, Portland, Oregon. Ray Sutter, Sutter Products Co., Dearborn, Mich., "Shell Molding."

18 . . Detroit

Detroit Leland Hotel, Detroit. Ray Gardner, Ford Motor Co., "Small Plant Quality Control."

19 . . Birmingham

Birmingham, Ala. Clyde A. Sanders, American Colloid Co., Chicago, "Effect of Mold Materials on Apparent Metal Shrinkage."

19-20 . . Chesapeake

Philadelphia, Pa. East Coast Regional Conference, Theme, "Economic Foundry Operations." Sponsored by Metropolitan, Philadelphia and Chesapeake chapters.

22 . . Northwestern Pennsylvania

Moose Club, Erie, Pa. Tom E. Barlow, Eastern Clay Products Div., International Mineral and Chemical Corp., Chicago, "High Pressure Molding."

26 . . Chesapeake

Engineers Club, Baltimore, Md. A. H. Hesse, Stemas, Inc., Chicago, "Aluminum Foundry Practice."

26 . . Ontario

General Brock Hotel, Niagara Falls, Ont. Past Chairman's Night. H. Mabson, I.A.P.A., Ont.

April

1 . . Canton District

Mergus Restaurant, Canton, Ohio. Tom Barlow, Eastern Clay Products Co., "Cupola Refractories."

2 . . Western New York

Hotel Sheraton, Buffalo, N. Y. Tom Barlow, Eastern Clay Products Co., Chicago, "Latest Developments in Pressure Molding."

5 . . Central Illinois

American Legion Hall, Peoria, Ill. H. H. Wilder, Vanadium Corp. of America, Detroit, "Gray Iron Metallurgy."

5 . . Central Indiana

Athenaeum, Indianapolis, J. B. Caine, "Rising and Gating."

5 . . Chicago

Chicago Bar Association, Chicago, Round Table. Gray Iron, S. C. Massari, Hansell Elcock Co., Chicago, "Good Castings Cheaper." Malleable, J. F. Kruger, International Harvester Co. "Improved Methods and Lower Cost." Non Ferrous, Steel Patt., Panel Discussion "Casting Design." Maintenance, H. D. Krummel, Socony Vacuum, "Foundry Lubrication."

5 . . Metropolitan

Essex House, Newark, N. J. Tom Muff,

Sorbo-Mat Process Engineers, "Phases of Foundry Control."

5 . . Western Michigan

Bill Stern's Restaurant, Muskegon Heights, Mich. William Ferrel, Auto Specialties Mfg. Co., "D Processing Molding."

6 . . Rochester

Seneca Hotel, Rochester, N. Y. A. F. Pfeiffer, Allis-Chalmers Mfg. Co., "Co-ordinative Function of Pattern Equipment and Castings."

8 . . Northeastern Ohio

Tudor Arms Hotel, Cleveland. Ray A. Witschey, A. P. Green Firebrick Co., "Refractories."

9 . . Texas

Lufkin, Texas.

9 . . Wisconsin

Hotel Schroeder, Milwaukee. Sectional Meeting.

12 . . Michiana

Warsaw, Ind. Entertainment Meeting. Dan Leedy, Dalton Foundries, Warsaw, Ind., in charge.

13 . . Twin City

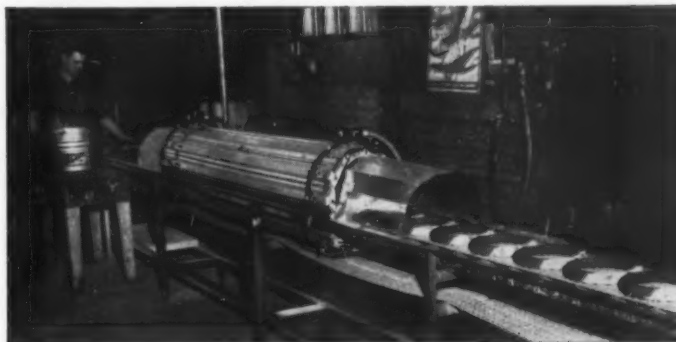
Covered Wagon, Minneapolis. Carl W. Sundberg, Minneapolis Electric Steel Castings Co., Minneapolis, "Better Casting Finish Through Tighter Sand Control."

18 . . Detroit

Detroit Leland Hotel, Detroit. Moderator, Cliff Hockman, Cadillac Motor Div., Detroit, "Molding Methods—Should you use 'C' process, 'D' process, dry sand, green sand, or permanent mold?"

Another CHROMALOX Production Tip

Core Drying Time Cut from 24 HOURS to 6 SECONDS!



PROBLEM

To speed up the drying of the dip-coat applied to cores for casting automotive parts. At least 24 hours drying time was

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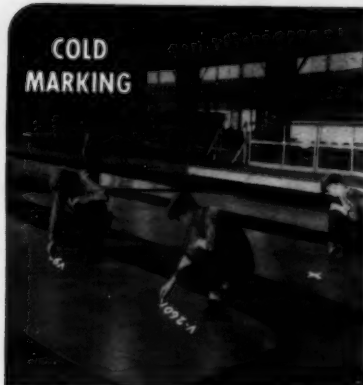
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Abstracts

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A357 . . "Studies in the Deoxidation of Iron," E. L. Evans and H. A. Sloman, *Journal of the Iron and Steel Institute*, vol. 174, no. 4, August 1953, pp. 318-324.

α -Ti₂O₃ is found in iron containing a residual excess of titanium from deoxidation. The compounds in inclusions, as excess titanium gives way to excess oxygen, tend to occur in the order: α -Ti₂O₃, Ti₂O₃, TiO₂, FeTiO₃, a spinel termed titanian magnetite, and Fe₂O₃. TiO was also found in some ingots containing excess titanium.

A358 . . "The Apparent Thermal Conductivities of Molding Materials at High Temperatures," D. V. Atterton, *Journal of the Iron and Steel Institute*, vol. 174, no. 3, July 1953, pp. 201-211.

The apparent thermal conductivities at low temperatures for bentonite-bonded silica sands are similar and of the order of 0.002 cgs units. Conductivity decreases somewhat up to 500 C, increase rapidly up to 1300 C, and continues to increase until it reaches 0.005 cgs units at 1600 C. Sand grain size, compact density, and binder content increases tend to increase the apparent thermal conductivity. Values for bentonite-bonded olivine sands and bentonite-bonded zircon sands are similar.

A359 . . "Composition Control of Steel Castings Improved by New Furnace Sampling Methods," V. E. Belusko, *Journal of Metals*, vol. 5, no. 11, November 1953, pp. 1430-1432.

The speed of single slag basic melting practice is increased by improved sampling methods for carbon and manganese analysis. The improvement consists of sampling the steel melt with a transmission suction gun and drawing it into a Pyrex tube. After the resulting sheathed wires are delivered to the laboratory, they undergo a rapid combustion carbon analysis. For slag viscosity tests the Herty viscosimeter is especially valuable for manganese steels. Necessary precautions are discussed.

A360 . . "Properties of Sand-Cast Mg-Th-Zn-Zr Alloys," K. E. Nelson, *Journal of Metals*, vol. 5, no. 11, November 1953, pp. 1493-1497.

A study on varying the zinc and

thorium contents of the above alloys shows that wide variation does not affect the good strength and ductility at 20 C or higher; that very high creep resistance, which is associated with a microstructure having jagged intermetallic plates in this system, is obtained at about 350 C from a thorium-zinc content different from that at room temperature; and that the 3% Th-2.5% Zn-0.7% Zr alloy is the best generally at high temperatures. Photomicrographs are shown.

A361 . . "An Analytical Study of the Die-Casting Process," Bruno Sachs, *ASTM Bulletin*, no. 192, September 1953, p. 27.

Quality requirements for die castings and the types of machines used are discussed. Based on mechanical, hydro and thermodynamic laws, equations expressing factors in the drive, return, metal and air systems have been developed to describe the process of die casting and the porosity.

A362 . . "Influence of Ramming and Sintering on the Penetration of Molten Metals into Compacted Silica Sand Mixes," T. P. Hoar, D. V. Atterton, and D. H. Houseman, *Journal of the Iron and Steel Institute*, no. 175, part 1, September 1953, pp. 19-29.

The influence of ramming on penetrating pressure, using tin and both fine- and coarse-grained bentonite-bonded silica sand, was studied. The pressure increased 75 per cent in both over the range 1/2-10 rams. Bulk density gradients and green air permeabilities were measured and found to correlate somewhat with penetrating pressure. Values for iron in place of tin were also obtained. Results are interpreted on the basis of the effective pore radius.

A363 . . "Modification of Light Hyper-silicate Alloys and the Corresponding Structures," Claude Mascré, *Fonderie*, no. 91, August 1953, pp. 3556-3564 (in French).

The effects of phosphorus and sodium on aluminum-silicon hypereutectic alloys are discussed, giving characteristics before modification, after introducing sodium and phosphorus separately, and after simultaneous introduction. The fineness of the structure reaches a maximum when the amount of phosphorus added is 0.01 per cent, rupture strength also reaching a maximum at this point. The effects on Brinell hardness and elongation are also covered.

A364 . . "Synthetic Resins in the Foundry," D. N. Buttrely and Y. W. Rayden, *La Fonderie Belge*, no. 9, September 1953, pp. 167-172 (in French).

Discusses the characteristics and uses of urea and phenolic resins in making cores. Cores made using resin as a binder have the following characteristics: baking times are shorter, high quality castings are possible, and the resin-sand mixtures are more adhesive than those having an oil base. Baking conditions, order, economics and green strength of the core are covered.

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Abstracts

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A365 . . "The Economical Production of High Quality Steel Castings," J. J. Dewez, *La Fonderie Belge*, no 9, September 1953, pp. 160-166 (in French).

The author discusses the role of each department in a foundry making steel castings. He discusses the processes of designing, melting, analysis, quality control, heat treatment and inspection. Ways in which departments should cooperate are mentioned. Factors governing choice of sands and other materials are also outlined.

A366 . . "Scrap Caused by Ruptures, Cavities, and Gas Inclusions in Mass Production of Solid Cast Iron Wheels by Semichill Casting," A. Pack, *Giesserei*, vol. 40, no. 21, October 15, 1953 (in German).

A German foundry with an output of about 7000 wheels a month has developed a statistical method for the evaluation of the process. The factors causing ruptures, cavities and gas inclusions were analyzed and the results corroborated by means of special experimental runs.

A367 . . "Contribution to the Knowledge of Cylindrical Samples from Analysis of Molding Sand Properties in the Compressed State," W. Goetz, *Giesserei*, vol. 40, no. 19, September 1953, pp. 469-477 (in German).

Features of the cylindrical samples from DIN-Entwurf 52-401 were studied by analysis of the molding sand in the compressed state. Results are compared with those from some American samples. The comparative study was made for the investigation of the effect of uneven compression on different sands. The variation between German and American samples, as proved by the comparison of compression research results, is small. Data are tabulated.

A368 . . "Sand Testing According to Swedish, German, and American Specifications," E. O. Lissell and O. Carlsson, *Giesserei*, vol. 40, no. 18, September 3, 1953, pp. 445-454 (in German).

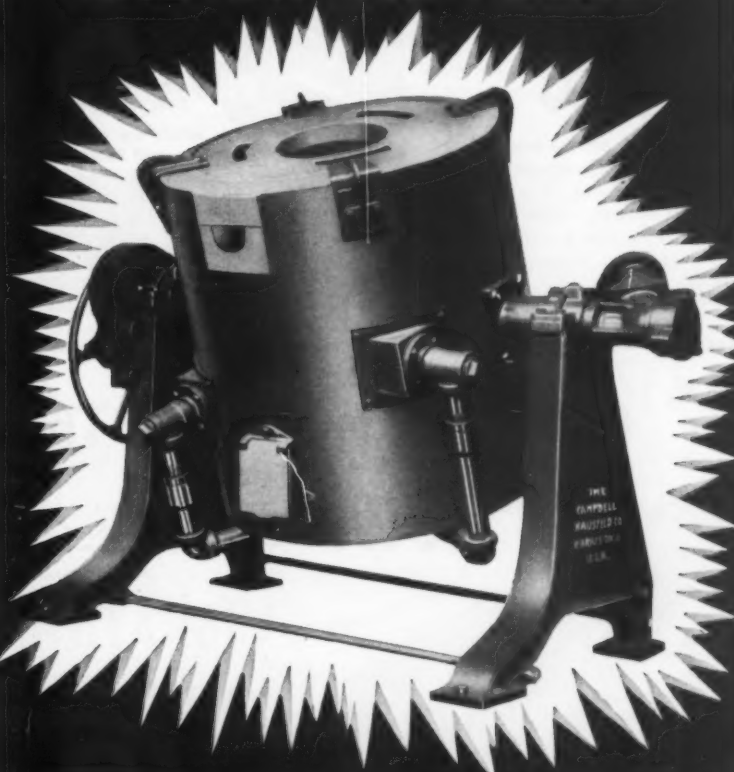
The preparation of Swedish sand testing specifications is treated; they are compared with the corresponding German and American specifications. The size of the sand grains are compared in a table. Samples were tested in the laboratory and under working conditions for fatigue and tensile strengths and permeability. Samples from the different sources gave results which closely agreed. By varying slightly the ramming apparatus used in testing, the correspondence was improved further. Sieve analysis of the sands is shown graphically by a summation curve. Methods of analyzing the medium grain sizes are given, and a diagram is shown which makes parallel use of German and American standards possible.

continued on page 112

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Abstracts

continued from page 111

A369 . . "Cement Sand Molds in the Steel Foundry," Giuseppe Lombardi, *La Fonderia Italiana*, vol. 2, no. 9, September 1953, pp. 571-576 (in Italian).

The author describes briefly foundry operations at the steel works Vanzetti in Milan, using molds made of cement, sand, and water. Advantages and defects of the procedure are pointed out. Among the latter is the necessity of interposing a waiting period of two or three days between the preparation of the mold and the foundry operation.

A370 . . "Several Considerations in the Use of Scrap Iron in the Cupola," Charles Dennerly, *Fonderie*, no. 91, August 1953, pp. 3539-3555 (in French).

The author discusses general theory of cupola operation, including thermal conditions in melting, the physical chemistry of castings at various temperatures, metallurgical considerations, and foundry problems. Other factors covered include the proper amount of oxygen and coke needed for efficient operation. Data are tabulated and graphed; 12 references.

A371 . . "High-Quality Cast Iron, with Special Reference to Those Having Compact or Spherical Graphite Formations," E. Piwowarsky, *Giesserei*, vol. 40, no. 19, September 17, 1953, pp. 477-482 (in German).

A review of earlier studies on spheroidal graphite, which has been known since 1914 and which has been present in cast iron alloys of high mechanical strength since 1923. The development of Bessemer steel as a result of the use of magnesium and calcium in desulfurization and deoxidation of cast iron and pig iron is dealt with. The latest developments in the U.S.A., Germany, Austria and Belgium have brought about manufacturing methods for high-strength ductile cast iron with spheroidal graphite formations. 17 references.

A372 . . "High-Speed Control with Automatic Sand System," *American Foundryman*, vol. 24, no. 5, November 1953, pp. 36-39.

Correct amounts of water and sand additives are added automatically in controlled-cycle sand mixers in sand system containing 200 tons of sand.

A373 . . "Continuous Casting of Copper-Base Alloy Stock," *American Foundryman*, vol. 24, no. 5, November 1953, pp. 40-41.

Picture story illustrating continuous casting of bars, tubes, and shapes.

A374 . . "Planning a System for Materials Handling," Kennard F. Lange, *American Foundryman*, vol. 24, no. 5, November 1953, pp. 42-47.

Lists five fundamental steps in formulating foundry materials handling systems and tells how to follow them.

continued on page 113

Abstracts

continued from page 112

A375 . . "Fast Polishing Method Brings Out Graphite," R. W. Lindsay and J. M. Snook, *American Foundryman*, vol. 24, no. 5, November 1953, pp. 48-50.

Details of rapid method of polishing developed for use with gray iron, white iron, malleable iron, and nodular iron metallographic specimens.

A376 . . "Carbon in Ferrous Alloys," Harry K. Ihrig and John T. Jarman, *American Foundryman*, vol. 24, no. 5, November 1953, pp. 52-57.

Why carbon is so important and how its amount and form influence ferrous alloys are shown by means of a series of experimental heats.

A377 . . "A Simple Six-Step Technique for Better Foundry Supervision," C. H. Broaded, *American Foundryman*, vol. 24, no. 5, November 1953, pp. 70-71.

What supervisors can do about mistakes made by employees under them.

A378 . . "Foundry Goes to College," L. F. Mondolfo, *American Foundryman*, vol. 24, no. 5, November 1953, pp. 72-73.

Modern college foundry instruction includes experiments designed to compare casting methods—in this case shell molding vs. green sand.

A379 . . "Investment Precision Casting," A. Dunlop, *Metal Industry*, vol. 83, no. 18, October 30, 1953, pp. 355-357, and vol. 83, no. 19, November 6, 1953, pp. 381-382.

Shaw process of investment casting bypasses the expendable pattern stage of traditional lost wax procedures by using a refractory slurry that gels, is then fired to make mold sections.

A380 . . "Zircon Sand," M. R. Hinchcliffe, *Metal Industry*, vol. 83, no. 22, November 27, 1953, pp. 437-440.

Use of zircon sand cores to solve difficult veining problem in phosphor bronze impellers is described.

A381 . . "Use of Asbestos in Foundry Operations," W. M. Halliday, *Canadian Metals*, vol. 16, no. 11, October 1953, pp. 28, 30, 32.

Molding tricks based on use of asbestos sheet and board show how to increase the thickness of a casting without pattern changes and how to use a split metal core for chilling hubs of pulleys.

A382 . . "Influence of Surface Rolling on the Fatigue Strength of Cast Iron," G. N. J. Gilbert and K. B. Palmer, *Journal of Research and Development, B.C.I.-R.A.*, vol. 5, no. 2, October 1953, pp. 71-77.

Fatigue strength of a pearlitic cast iron was increased 20 per cent by rolling. Authors believe this is due to any of the following: compressive stresses induced in surface layers; work hardening of surface; more favorable distribution of graphite flakes in surface layers.

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Abstracts

continued from page 113

A-383 . . "A Rationalization of Measured High Temperature Properties of Fe-Cr-Co-Ni Alloys." J. D. Nisbet and W. R. Hibbard, *Journal of Metals*, vol. 5, no. 9, September 1953, pp. 1149-1165.

High temperature properties of binary, ternary and quaternary Fe-Ni-Cr-Co alloys and the effects of incongruous single additions were analyzed to find the 1000 hr-1500 F rupture strength from tensile and rupture strengths up to 2000 F and to characterize the alloys as alloys from solid solutions, allotropic transformations, precipitation hardening and multiple phases. Factors such as relative melting points and atom sizes, recrystallization, recovery and their interactions are emphasized.

A384 . . "Shell Molding of Stainless Steel," Walter H. Dunn and Robert E. Day, *Product Engineering*, vol. 24, no. 9, September 1953, pp. 129-133.

Shell mold casting of stainless steel aircraft parts is described and the process is compared with investment casting, baked sand casting, precision forging, welded assemblies, and machined parts.

A385 . . "Operating Experiences with Hot-Blast Cupolas in Great Britain," F. C. Evans, *Foundry Trade Journal*, vol. 95, no. 1924, July 16, 1953, pp. 73-78, and vol. 95, no. 1925, July 23, 1953, pp. 113-117.

Three of the four (as of February 1953) hot-blast cupola installation in England are described. Operating characteristics and mechanical details are given.

A386 . . "Mechanical Handling Systems, with particular Reference to the Vitreous Enamelling Industry," J. Bain, *Foundry Trade Journal*, vol. 95, no. 1931, September 3, 1953, pp. 295-302.

Describes and illustrates mechanical handling facilities and includes floor layout of mechanized plant for production of enamelled kitchenware.

A387 . . "Production of Spheroidal Graphite Cast Iron in a High-Frequency Furnace," B. Jones and R. Jelley, *Foundry Trade Journal*, vol. 95, no. 1932, September 10, 1953, pp. 313-319.

Tells how nodular iron was produced from various combinations of pig, steel scrap, and ferroalloys in an acid-lined, high-frequency induction furnace.

A388 . . "The Fluidity of Molten Steel," B. G. Rightmire and H. F. Taylor, *Journal of the Iron and Steel Institute*, vol. 175, part 2, October 1953, pp. 167-176.

A quantitative evaluation of flow of liquid metal which (1) indicates that the spiral is a dependable shop tool, (2) develops an equation that fits data of various investigators, and (3) shows that superheat is the predominant influence in metal flowability.

THE MOLDER AND THE DEVIL

A tough old molder died and went to Hell.

Satan met him at the gate, exclaiming, "Well!

Since the Lord to me has sent you, I'll find some way to torment you." So he shouted with a diabolic grin, "Light the brimstone pits and throw this molder in!

On the grates he'll writhe and turn, Toss him in and let him burn! Where his hours he may while Away in Hell's traditional style!" But the molder shifted slightly on his feet

And muttered, "You can't hurt me with your heat.

I've poured steel heats without number On the hottest days of summer With the steel and sweat a-flying Till you think that you are dying And your helpers all a sighing And the boss beside you crying—with a shout—

"Pour her faster! Faster! Fill her up!! The ladle's bustin' out!!"

Other things in Hell may have this molder beat, But you'll find you'll never hurt me with your heat.

• • •

Satan called his imps and said to them, "Now boys,

Take this man away and torture him with noise."

But the molder only grinned and said, "Now see,

I think you'll find that noise don't bother me.

I've worked where flasks were moving with a rattle and a bang.

With boards and buckets flying with a clatter and a clang,

While the molders' rammers patter And the chipping guns they chatter

And the hammers bang and batter Till on the roof the shingles shatter."

You may find some way to craze me But your noise will never faze me.

• • •

Then the Devil said, "This man can really take it.

His spirit's high; I'll find a way to break it.

Since we cannot torment him with heat or with noise,

We'll work him to death; Get on to him, boys."

The molder stood up, held his head high and proud,

Reared back and chuckled, then laughed right out loud.

"I've worked a whole lifetime with rammer and slick;

I've shoveled and hammered when I was so sick

That I can't tell you how I got through the trick.

While the cores were still a-baking The mold I was a-making, A riddle I was shaking With my bones and muscles aching Till I thought my back was breaking!" Fair weather and foul, I've slaved like a Turk Something might harm me, but it sure won't be work!"

• • •

The Devil said, "Well, Molder, I've consulted with the clerk And we find we cannot torture you with heat or noise or work. All of Hade's tribulations, from the last one to the first,

When we try them out on you, we always find that you've seen worse. You've worried, toiled and sweated since the day that gave you birth, So we're sending you to Heaven, For you had your Hell on Earth!"

From Rammed Up and Poured, book of foundry poems by Bill Walkins, obtainable from the copyright owners: Electric Steel Foundry Co., 2141 North West 25th Ave., Portland 10, Oregon. Price, \$1.85.

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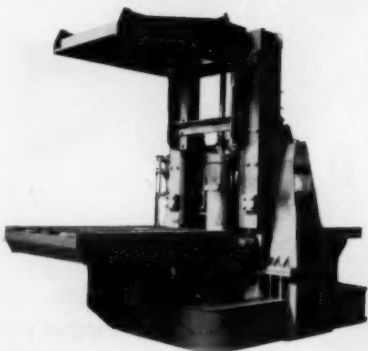
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